MAINTENANCE MANUAL
for
Nicolet Instrument Corporation
Models 1090A and 1090AR
DIGITAL OSCILLOSCOPES

Including
Models 93A and 94A Plug-Ins
and
C and D Input Amplifiers

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TABLE OF CONTENTS

	Page
Introduction	1
Models Covered	1
Ordering Replacement Parts	1
Special Test Equipment	5
Calibration and Alignment Procedures	6
C Amplifier	6
D Amplifier	14
93A Plug-In	23
Description of Power Converter Operation	51
Schematic Diagrams	56
Parts List	75

INTRODUCTION

Models Covered

This manual includes maintenance instructions for the Nicolet 1090A and 1090AR Digital Oscilloscopes, Model 93A and 94A Plug-Ins, and Type C and D Input Amplifiers.

Instructions on operation and maintenance for the accessories (NIC-283A, NIC-287A, NIC-288A, NIC-191A, NIC-192, NIC-193 and NIC-194) are contained in the separate manuals for each accessory.

Ordering Replacement Parts

The last section of this manual contains a complete parts list. A Nicolet stock number is provided for each part and, where applicable, a manufacturer's name and part number are also provided. Please give the Nicolet stock number and description when ordering parts.

NOTE

All integrated circuits are pre-tested by their manufacturers to Nicolet specifications. ORDER INTEGRATED CIRCUITS ONLY FROM NICOLET.

NOTE

The eleven Programmable Read Only Memories (PROM's) located on Boards I and II are programmed by Nicolet for specific input/output interfaces. THESE PROM'S MUST BE ORDERED ONLY FROM NICOLET.

The PROM's are offered in four sets of 11 each and are used as follows:

Set	Use
BA	Interfaces to NIC-283A and NIC-287A or NIC-288A Magnetic Tape Recorder
BB	Interfaces to NIC-191A Calculator Interface

BC Interfaces to NIC-193 Cassette Tape System

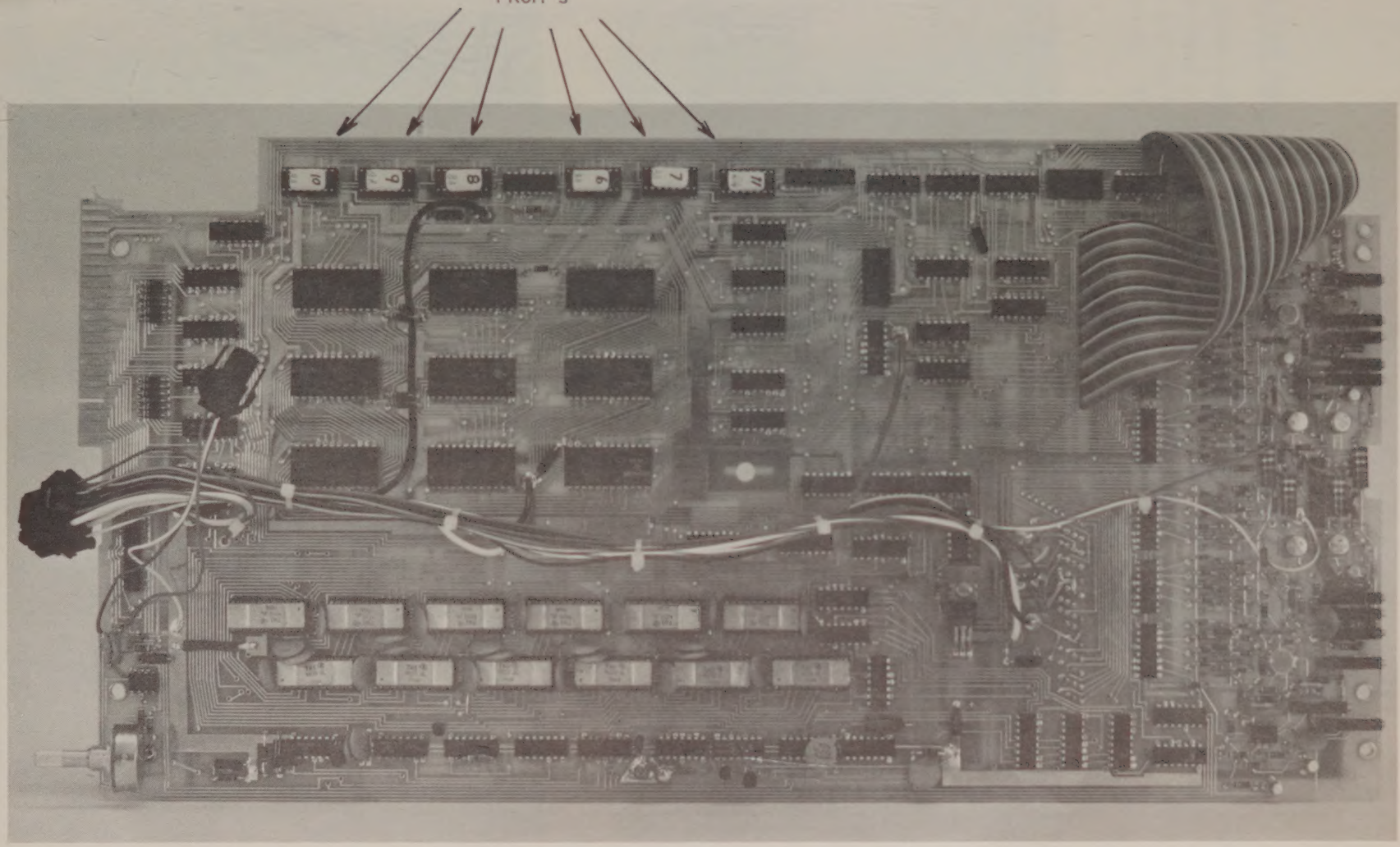
BE Provides parallel 12-bit output

PROM's 1 through 5 are located on Board II.

PROM's 6 through 11 are located on Board I.

Exact locations are shown on the accompanying photographs.

BOARD I



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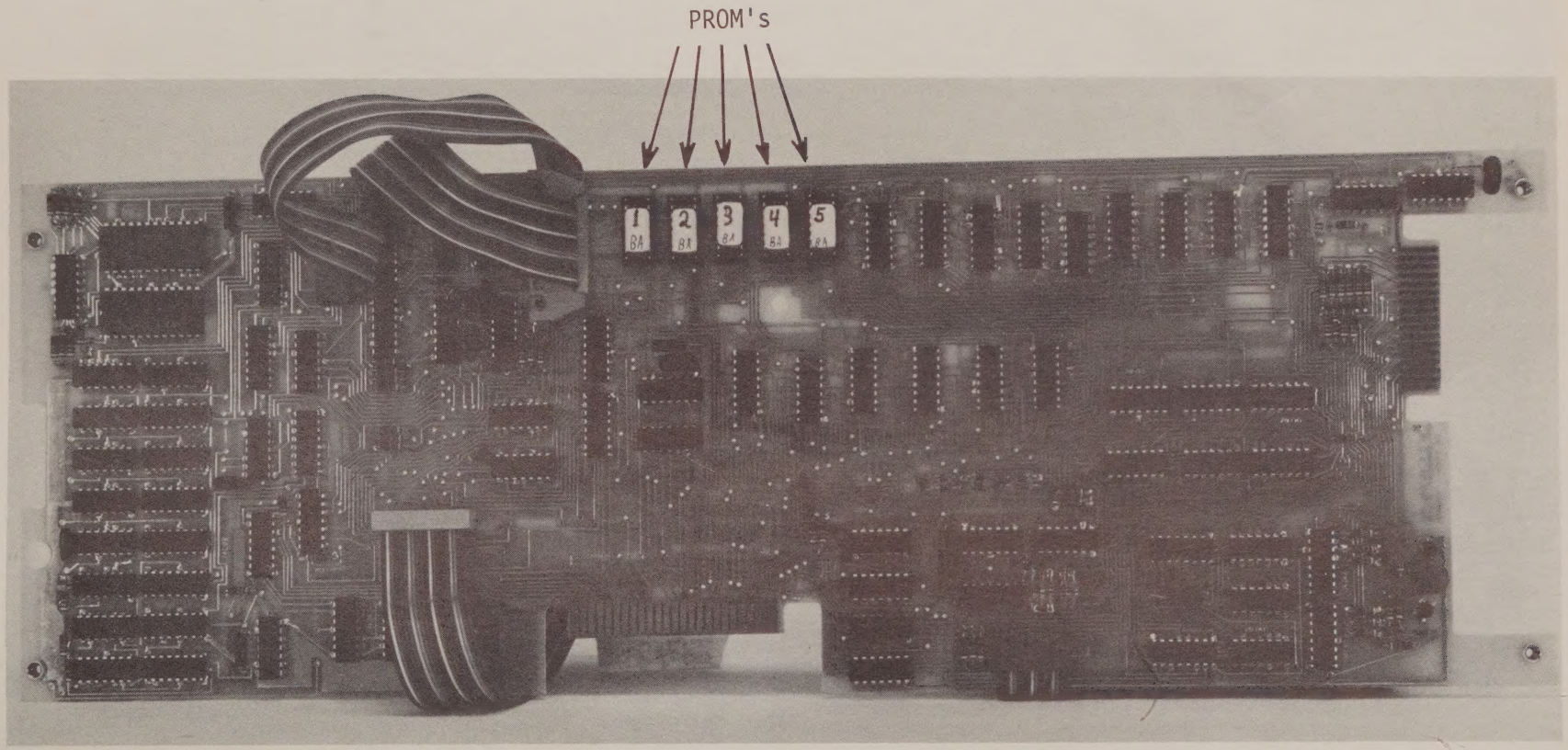
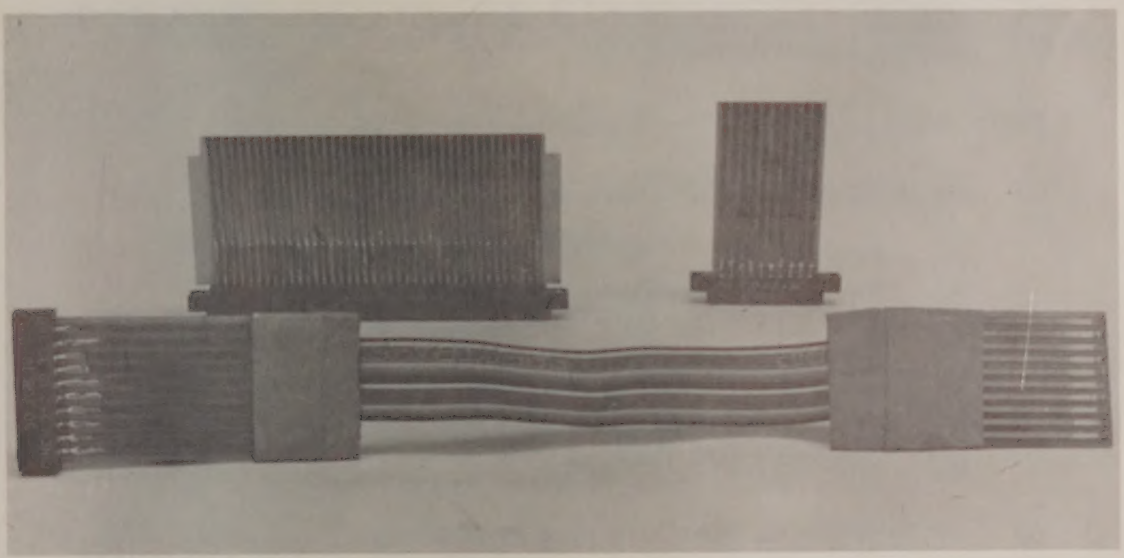
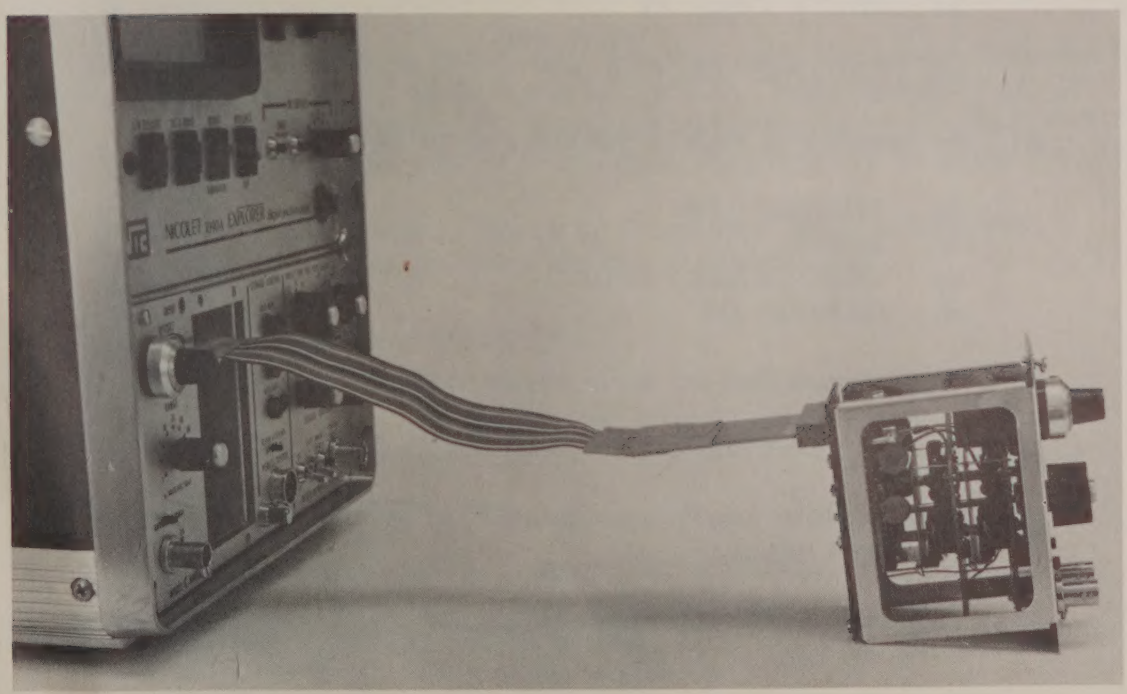


Special Test Equipment

Shown below are the extender cable required for alignment/calibration of the C and D input amplifiers, the small circuit board extender for the 93A digitizer boards and the large circuit board extender for the 93A memory, pulser and control boards. This special test equipment may be ordered from Nicolet.





C Amplifier Gain Calibration Procedure

The following equipment is required to accurately calibrate the gain of the Model C amplifier:

(1) Stabilized DC power supply, 0 - 40 vdc range
(2) Digital voltmeter, ±0.01% accuracy
(3) Signal generator, square wave, 7 kHz, 40 v p/p
(4) Extender cable assembly for connecting C amplifier to 93A plug-in
(5) Insulated shaft adjusting tool

Perform the calibration with this procedure:

(1) Set switches on Model 1090A/AR main frame as follows:

(a) POWER: ON
(b) EXPANSION switches: Both OFF
(c) AUTOCENTER: OFF
(d) DISPLAY: Y/T
(e) MEMORY: ALL
(f) NUMERICS: OFF
(g) NON INVERT: Pressed

(2) Set switches on Model 93A plug-in as follows:

(a) RETAIN REFERENCE: OFF
(b) SWEEP TIME: ×1
1 MICROSEC
(c) TRIGGER: RECURRENT

(3) Set switches on Model C amplifier as follows:

(a) FILTER: OFF
(b) RANGE: 1
(c) GND/NORMAL: GND
(d) ON/OFF: ON

(4) Connect stabilized DC power supply to Model C amplifier.

(5) Connect digital voltmeter to power supply.

(6) Turn on power supply and voltmeter and permit units to warm up for at least 15 minutes.

(7) Turn on voltmeter and power supply and adjust power supply output to +2.000 VDC.

(8) Press LIVE pushbutton on Model 93A plug-in. Adjust trigger THRESHOLD control to obtain voltage trace on cathode ray tube (CRT).

(9) Adjust OFFSET control so that DC input signal trace is near bottom of the CRT display.

(10) Press HOLD LAST pushbutton on Model 93A plug-in.

(11) Read - voltage on CRT numerics. Note this reading. It should be -1.000. If it is not, press LIVE pushbutton and readjust OFFSET control. Then repeat steps 8 through 11 until the -1.000 reading is achieved.

NOTE: Do not adjust OFFSET control again until this procedure is complete.

(12) Set GND/NORMAL switch to NORMAL.

(13) Press LIVE pushbutton, then press HOLD LAST pushbutton.

(14) Read voltage on CRT numerics. It should be 1.000 (±0.005). If it is not, press LIVE, adjust gain control on front panel of Model C amplifier with a small screwdriver, press HOLD LAST to check numerics and repeat until specified voltage is achieved.

NOTE: Use banana-to-BNC plug on C Amplifier input to wiggle C Amplifier back and forth slightly to help remove it from 93A plug-in.

(15) Turn off power on 1090A/AR, remove C Amplifier, insert extender cable, and reconnect C Amplifier to 93A plug-in. Keep extender cable flat between C Amplifier and 93A plug-in when they are properly oriented (i.e., both right side up in this case) to assure it is properly installed.

NOTE: Refer to Figure 1, C Amplifier Adjustment Points Diagram, for location of adjustments.

(16) Turn on power on 1090A/AR.

Adjust ±2 Volt Range

(17) Set RANGE selector to 2.

(18) Increase power supply voltage to +4.000 VDC.

(19) Set GND/NORMAL switch to GND.

(20) Press LIVE pushbutton, then press HOLD LAST pushbutton and read - voltage on CRT numerics. It should be -2.000. Press LIVE, adjust OFFSET, then press HOLD LAST and check again. Repeat until -2.000 is achieved.

(21) Set GND/NORMAL switch to NORMAL.

(22) Press LIVE pushbutton, then press HOLD LAST pushbutton and check for 02.000 (±0.010) on CRT numerics. Adjust R2, if necessary, to achieve. To adjust, press LIVE, adjust R2, press HOLD LAST and check results.

(23) Repeat steps 19 through 22 until no further adjustments are required.

Adjust ±4 Volt Range

(24) Set RANGE selector to 4.

(25) Increase power supply voltage to +8.000 VDC.

(26) Set GND/NORMAL switch to GND.

(27) Press LIVE pushbutton, then press HOLD LAST pushbutton and read - voltage on CRT numerics. It should be -04.000. Press LIVE, adjust OFFSET, then press HOLD LAST and check again. Repeat until -4.000 is achieved.

(28) Set GND/NORMAL switch to NORMAL.

(29) Press LIVE pushbutton, then press HOLD LAST pushbutton and check for 04.000 (±0.020) on CRT numerics. Adjust R3, if necessary, to achieve. To adjust, press LIVE, adjust R3, press HOLD LAST and check results.

(30) Repeat steps 26 through 29 until no further adjustments are required.

Adjust ±10 Volt Range

(31) Set RANGE selector to 10.

(32) Increase power supply voltage to +20 VDC.

(33) Set GND/NORMAL switch to GND.

(34) Press LIVE pushbutton, then press HOLD LAST pushbutton and read - voltage on CRT numerics. It should be -10.000. Press LIVE, adjust OFFSET, then press HOLD LAST and check again. Repeat until -10.000 is achieved.

(35) Set GND/NORMAL switch to NORMAL.

(36) Press LIVE pushbutton, then press HOLD LAST pushbutton and check for 10.000 (±0.050) on CRT numerics. Adjust R4, if necessary, to achieve. To adjust, press LIVE, adjust R4, press HOLD LAST and check results.

(37) Repeat steps 33 through 36 until no further adjustments are required.

Adjust ±100 Volt Range

(38) Set RANGE selector to 100.

(39) Increase power supply voltage to +40 VDC.

(40) Set GND/NORMAL switch to GND.

(41) Press LIVE pushbutton, then press HOLD LAST pushbutton and read - voltage on CRT numerics. It will be about -100.00. It should be -20.000. Press LIVE, adjust OFFSET many turns, then press HOLD LAST and check again. Repeat until -20.000 is achieved.

(42) Set GND/NORMAL switch to NORMAL.

(43) Press LIVE pushbutton, then press HOLD LAST pushbutton and check for +20.000 (±0.100) on CRT numerics. Adjust R5, if necessary, to achieve. To adjust, press LIVE, adjust R5, press HOLD LAST, and check results.

(44) Repeat steps 40 through 43 until no further adjustments are required.

NOTE: This completes the C Amplifier Gain adjustments. The 20, 40, 200, and 400 ranges do not require calibration since they are derived from combinations of the other calibrated dividers.

C Amplifier Frequency Compensation Adjustments

(45) Turn off the power supply and digital voltmeter and disconnect them from the 1090A/AR.

(46) Connect signal generator output to C Amplifier and connect signal generator trigger output to 93A plug-in TRIGGER INPUT. Turn on signal generator and warm up for several minutes.

NOTE: The 1 Volt range does not require frequency compensation adjustment.

Adjust Compensation in 2 Volt Range

(47) Set RANGE selector to 2. Set TRIGGER CONTROL to EXT, AC/DC to AC, SLOPE to + and adjust THRESHOLD, if required.

(48) Adjust signal generator for a 7 kHz square wave output which is approximately 2/3 of full scale on 1090A/AR CRT. Adjust by pressing LIVE pushbutton and adjusting OFFSET and signal generator output.

(49) Set HORIZONTAL EXPANSION to ON and ×8. This permits you to closely inspect the leading edge of the square wave.

NOTE: In adjusting the frequency compensation capacitors, the stray capacitance of the adjusting tool will affect the results. Make the adjustment and then withdraw the tool to check results.

(50) Adjust C1 for best square wave.

(51) Set HORIZONTAL EXPANSION to OFF.

Adjust Compensation in 4 Volt Range

(52) Set RANGE selector to 4.

(53) Adjust signal generator for a 7 kHz square wave output which is approximately 2/3 of full scale on 1090A/AR CRT. Adjust by pressing LIVE pushbutton and adjusting OFFSET and signal generator output.

(54) Set HORIZONTAL EXPANSION to ON to closely inspect leading edge of square wave.

(55) Adjust C2 for best square wave.

(56) Set HORIZONTAL EXPANSION to OFF.

Adjust Compensation in 10 Volt Range

(57) Set RANGE selector to 10.

(58) Adjust signal generator for a 7 kHz square wave output, which is approximately 2/3 of full scale on 1090A/AR CRT. Adjust by pressing LIVE pushbutton and adjusting OFFSET and signal generator output.

(59) Set HORIZONTAL EXPANSION to ON to closely inspect leading edge of square wave.

(60) Adjust C3 for best square wave.

(61) Set HORIZONTAL EXPANSION to OFF.

Adjust Compensation in 20 Volt Range

(62) Set RANGE selector to 20.

(63) Adjust signal generator for a 7 kHz square wave output which is approximately 2/3 of full scale on 1090 A/AR CRT. Adjust by pressing LIVE pushbutton and adjusting OFFSET and signal generator output.

(64) Set HORIZONTAL EXPANSION to ON to closely inspect leading edge of square wave.

(65) Adjust C4 for best square wave.

(66) Set HORIZONTAL EXPANSION to OFF.

Adjust Compensation in 40 Volt Range

(67) Set RANGE selector to 40.

(68) Adjust signal generator for a 7 kHz square wave output which is approximately 2/3 of full scale on 1090A/AR CRT. Adjust by pressing LIVE pushbutton and adjusting OFFSET and signal generator output.

(69) Set HORIZONTAL EXPANSION to ON to closely inspect leading edge of square wave.

(70) Adjust C5 for best square wave.

(71) Set HORIZONTAL EXPANSION to OFF.

Adjust Compensation in 100 Volt Range

(72) Set RANGE selector to 100.

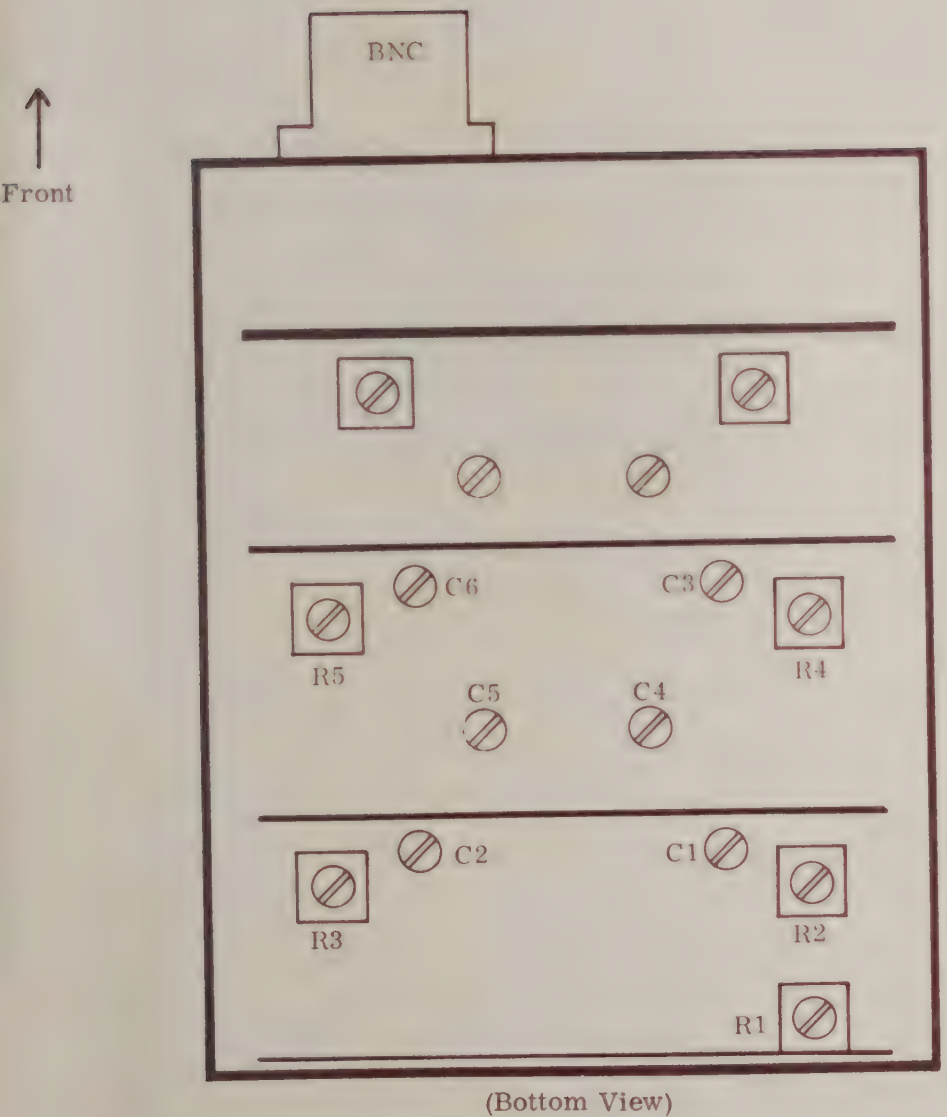
(73) Adjust signal generator for a 7 kHz square wave output which is approximately 2/3 of full scale on 1090A/AR CRT. Adjust by pressing LIVE pushbutton and adjusting OFFSET and signal generator output.

(74) Set HORIZONTAL EXPANSION to ON to closely inspect leading edge of square wave.

(75) Adjust C6 for best square wave.

(76) Set HORIZONTAL EXPANSION to OFF.

NOTE: This completes the Frequency Compensation adjustment procedure for the C Amplifier. The C Amplifier is now fully calibrated.



CAUTION

Do not adjust the four unlabeled controls. They are pre-set at time of initial checkout after unit is built.

Figure 1 - C Amplifier Adjustment Points Diagram

D Amplifier Calibration Procedure

The following equipment is required to accurately calibrate the differential Model D Amplifier:

(1) Signal generator, 1 kHz, at least 10 V p/p square wave.
(2) Cable from signal generator with short branch on 1090A/AR end so both inputs of D Amplifier are fed same signal with minimum noise.
(3) Stabilized DC power supply, 0 to 40 VDC range
(4) Extender cable assembly for connecting D Amplifier to Model 93A Plug-In.
(5) Insulated shaft adjusting tool
(6) Digital voltmeter, 0-100 V range, ±0.01% accuracy

Perform the calibration with this procedure:

(1) Set switches on Model 1090A/AR main frame as follows:

(a) POWER: OFF
(b) EXPANSION switches: Both OFF
(c) AUTOCENTER: OFF
(d) DISPLAY: Y/T
(e) MEMORY: ALL
(f) NUMERICS: OFF
(g) NON INVERT: Pressed

(2) Set switches on Model 93A Plug-In as follows:

(a) RETAIN REFERENCE: OFF
(b) SWEEP TIME: ×1, 1 MICROSEC
(c) TRIGGER: RECURRENT
(d) AC/DC: AC
(e) SLOPE: +

NOTE: Use banana-to-BNC plug on D Amplifier input to wiggle D Amplifier back and forth slightly to help remove it from 93A plug-in.

(3) Set switches on Model D Amplifier, which is connected to 93A plug-in by an extender cable, as follows:

(a) FILTER: OFF
(b) RANGE: 100 mV
(c) GND/NORMAL: Both to GND
(d) ON/OFF: ON

NOTE: When D Amplifier is on extender cable, cable must be flat between D Amplifier and 93A plug-in when they are properly oriented (i.e., when both are right side up) in order to have it plugged in properly.

(4) Set POWER switch on 1090A/AR main frame to ON and permit the 1090A/AR and the DC power supply and signal generator (neither of which is connected at this time) to warm up for at least 15 minutes.

(5) Press LIVE pushbutton on 93A plug-in.

D Amplifier Differential Balance Procedure

(6) Adjust OFFSET control on D Amplifier so that baseline is approximately centered on the CRT.

(7) Switch between 100, 200 and 400 mV positions on RANGE selector and observe the baseline trace. Adjust Differential Amplifier Balance R1 (see diagram at the end of this procedure) to minimize variations noted in trace location. Continue to adjust R1 until there are no apparent differences in position as the RANGE selector is moved between the three points.

NOTE: Capacitance of adjusting tool will affect results. For accuracy, make adjustment, withdraw tool, and then note the results.

(8) When variations in position noted in step 7 are minimal, set VERTICAL EXPANSION to ×32 and ON.

(9) Set AUTOCENTER to ON and then to OFF.

(10) Switch between 100, 200, and 400 mV positions on RANGE selector and check to see if the baseline trace remains in the same position. Adjust R1 to minimize any variations noted.

(11) Repeat adjustment steps 9 and 10 until the differential amplifier is completely nulled.

(12) Set VERTICAL EXPANSION to OFF.

NOTE: Adjusting the +400, +200, and +100 mV ranges (on + channel) automatically calibrates these ranges on the - channel.

(13) Connect stabilized dc power supply to + input channel of D Amplifier.

(14) Connect voltmeter to power supply, turn on both units and adjust power supply to +800 mV.

Calibrate 400 mV Range

(15) Set FILTER to 0.5 MHz to minimize noise.

(16) Set RANGE selector to 400 mV.

(17) Press LIVE pushbutton, then press HOLD LAST pushbutton and check CRT numerics for -0400.0. If it is not, press LIVE, adjust OFFSET, then press HOLD LAST and check again. Repeat until -0400.0 is achieved.

(18) Set + input channel to NORMAL.

(19) Press LIVE pushbutton, then press HOLD LAST pushbutton and check for 0400.0 ($\pm$0.002) on CRT numerics. Adjust front panel gain control, if necessary, to achieve. To adjust, press LIVE, adjust gain control, press HOLD LAST, and check results.

NOTE: Adjusting front panel gain control affects dc offset which may shift waveform off scale. OFFSET control will probably require adjustment as in step 17.

(20) Repeat steps 17 through 19 until both adjustments have been achieved.

Calibrate 200 mV Range

(21) Adjust power supply to +400 mV.

(22) Set RANGE selector to 200 mV.

(23) Set + input channel to GND.

(24) Press LIVE pushbutton, then press HOLD LAST pushbutton and check CRT numerics for -0200.0. If it is not, press LIVE, adjust OFFSET,

then press HOLD LAST and check again. Repeat until -0200.0 is achieved.

(25) Set + input channel to NORMAL.

(26) Press LIVE pushbutton, then press HOLD LAST pushbutton and check for 0200.0 (±0.001) on CRT numerics. Adjust gain control R2 to achieve. To adjust, press LIVE, adjust R2, press HOLD LAST, and check results.

NOTE: Adjusting front panel gain control affects dc offset which may shift waveform off scale. OFFSET control will probably require adjustment as in step 23.

(27) Repeat steps 23 through 26 until both adjustments have been achieved.

Calibrate 100 mV Range

(28) Adjust power supply to +200 mV.

(29) Set RANGE selector to 100 mV.

(30) Set + input channel to GND.

(31) Press LIVE pushbutton, then press HOLD LAST pushbutton and check CRT numerics for -100.00. If it is not, press LIVE, adjust OFFSET, then press HOLD LAST and check again. Repeat until -100.00 is achieved.

(32) Set + input channel to NORMAL.

(33) Press LIVE pushbutton, then press HOLD LAST pushbutton and check for 100.00 (±0.0005) on CRT numerics. Adjust gain control R3 to achieve. To adjust, press LIVE, adjust R3, press HOLD LAST and check results.

NOTE: Adjusting front panel gain control affects dc offset which may shift waveform off scale. OFFSET control will probably require adjustment as in step 30.

(34) Repeat steps 30 through 33 until both adjustments have been achieved.

Calibrate +1 V Range

(35) Adjust power supply for 2.000 volts.

(36) Set RANGE selector to 1.

(37) Set + input channel to GND.

(38) Press LIVE pushbutton, then press HOLD LAST pushbutton and check CRT numerics for -1.0000. If it is not, press LIVE, adjust OFFSET, then press HOLD LAST and check again. Repeat until -1.000 is achieved.

(39) Set + input channel to NORMAL.

(40) Press LIVE pushbutton, then press HOLD LAST pushbutton and check for 1.0000 (±0.005) on CRT numerics. Adjust gain control R4 to achieve. To adjust, press LIVE, adjust R4, press HOLD LAST and check results.

(41) Repeat steps 37 through 40 until both adjustments have been achieved.

Calibrate +10 V Range

(42) Adjust power supply for 20.000 volts.

(43) Set RANGE selector to 10.

(44) Set + channel to GND.

(45) Press LIVE pushbutton, then press HOLD LAST pushbutton and check CRT numerics for -10.000. If it is not, press LIVE, adjust OFFSET, then press HOLD LAST and check again. Repeat until -10.000 is achieved.

(46) Set + input channel to NORMAL.

(47) Press LIVE pushbutton, then press HOLD LAST pushbutton and check for 10.000 (±0.050) on CRT numerics. Adjust gain control R5 to achieve. To adjust, press LIVE, adjust R5, press HOLD LAST and check results.

(48) Repeat steps 44 through 47 until both adjustments have been achieved.

(49) Turn off and disconnect DC power supply and digital voltmeter. This completes the gain adjustment portion of the D Amplifier calibration procedure.

Common Mode (Differential Amplifier) Calibration

(50) Connect signal generator to both inputs of D Amplifier using a cable with a short branch on the 1090A/AR end so that both inputs are fed the same signal with minimum noise. Connect signal generator synch output to 93A plug-in TRIGGER INPUT. Turn on signal generator for warm up.

NOTE: The following steps basically consist of achieving the best common mode rejection characteristics on several input ranges. The end result of these steps is to calibrate the - channel of the D Amplifier.

Calibrate - : 10 Attenuator

(51) Press LIVE pushbutton.

(52) Set both + and - channels on D Amplifier to NORMAL.

(53) Set FILTER to 0.5 MHz.

(54) Set RANGE selector to 1.

NOTE: On the next step and all similar steps in the common mode and frequency compensation adjustments, the displayed waveform will be virtually a straight line if the adjustment is nearly perfect to start with. The waveform from the signal generator will be visible only after the VERTICAL EXPANSION switch is turned on in succeeding steps.

(55) Select EXT TRIGGER on 93A plug-in and adjust TRIGGER THRESHOLD for stable display as you adjust signal generator for a 1 kHz, approximately 10 V p/p sine wave.

(56) Adjust : Attenuator R6 for best common mode rejection; that is, for the smallest amplitude sine wave that can be achieved.

(57) Set VERTICAL EXPANSION to ON and ×64 and adjust Attenuator R6 again for best common mode rejection.

(58) Set VERTICAL EXPANSION to OFF.

Calibrate - ÷ 100 Attenuator

(59) Select 10 on RANGE selector.

(60) Increase output of signal generator to 20 V p/p.

(61) Adjust ÷ 100 Attenuator R7 for best common mode rejection.

(62) Set VERTICAL EXPANSION to ON.

(63) Readjust R7 for best common mode rejection.

(64) Set VERTICAL EXPANSION to OFF.

Start D Amplifier Frequency Compensation Calibration

NOTE: Capacitance of adjusting tool will affect results. For accuracy make adjustments, withdraw tool, and note final results.

Adjust + ÷ 10 Attenuator C1

(65) Adjust signal generator for a 1 kHz, approximately 4 V p/p square wave output.

(66) Select 2 on RANGE selector.

(67) Set - channel to GND.

(68) Press LIVE pushbutton and adjust signal generator for a square wave which is approximately 2/3 full scale in amplitude on 1090A/AR CRT.

(69) Set AUTOCENTER to ON and set VERTICAL EXPANSION to ON and ×8.

(70) Adjust + ÷ 10 C1 for best square wave.

(71) Set AUTOCENTER to OFF. Set VERTICAL EXPANSION to OFF.

Adjust + ÷ 100 Attenuator C2

(72) Select 10 on RANGE selector.

(73) Adjust signal generator for a square wave which is approximately 2/3 full scale in amplitude on 1090A/AR CRT.

(74) Set AUTOCENTER to ON and set VERTICAL EXPANSION to ON.

(75) Adjust + ÷ 100 C2 for best square wave.

(76) Set AUTOCENTER to OFF. Set VERTICAL EXPANSION to OFF.

Adjust - ÷ 10 Attenuator C3

(77) Set + channel to GND.

(78) Set - channel to NORMAL.

(79) Select 2 on RANGE selector.

(80) Adjust signal generator for a square wave which is approximately 2/3 full scale in amplitude on 1090A/AR CRT.

(81) Set AUTOCENTER to ON and set VERTICAL EXPANSION to ON.

(82) Adjust - ÷ 10 C3 for best square wave.

(83) Set AUTOCENTER to OFF. Set VERTICAL EXPANSION to OFF.

Adjust - ÷ 100 Attenuator C4

(84) Select 10 on RANGE selector.

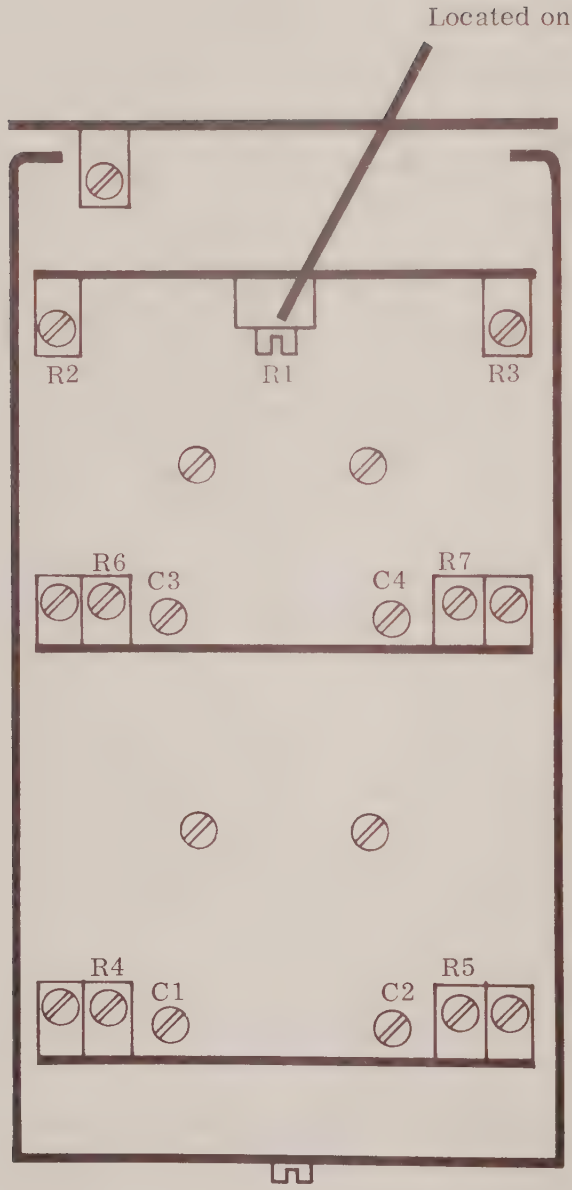
(85) Adjust signal generator for a square wave which is approximately 2/3 full scale in amplitude on 1090A/AR CRT.

(86) Set AUTOCENTER and VERTICAL EXPANSION to ON.

(87) Adjust - ÷ 100 C4 for best square wave.

(88) Set AUTOCENTER and VERTICAL EXPANSION to OFF.

This completes the calibration of the D Amplifier.



CAUTION

Do not adjust the nine
unlabeled controls.
They are pre-set at
time of initial checko
after unit is built.

Figure 2. D Amplifier Adjustment Points Diagram (Bottom View)

ADC ALIGNMENT, MODEL 93A PLUG-IN

This alignment procedure should be accomplished only by personnel with a good working knowledge of the Model 93A analog-to-digital converter (ADC). Without this knowledge the procedure will be difficult to complete.

To begin with we must define two terms: A/D "separations" and A/D "glitches". A separation appears as a break, or discontinuity, in the displayed waveform. (See Figures 5A and 5B.) Separations are normally caused by misalignment of the Digital-to-Analog (D/A) adjustments. A glitch appears as a flattening, and then a break or discontinuity, of the displayed waveform. (See Figures 6A and 6B.) Glitches are normally caused by misaligned bias or dc offset adjustments.

Equipment Required

(1) Test oscilloscope and probes, at least 35 MHz bandwidth

(2) Signal generator, 1 KHz triangular wave, 4V p/p

(3) DC voltmeter, 0–40 vdc range, accuracy ±0.05%

(4) Insulated shaft adjusting tool

(5) Extender cable, 1090 main frame to 93 plug-in removed from main frame

NOTE: Assure signal generator, 1090A/AR, and test oscilloscope have a common ground.

NOTE: Remove protective covers from both sides and bottom of 1090A/AR and set it on test bench. For first procedure, Voltage Supply Check, slide 93A plug-in out of main frame for access.

VOLTAGE SUPPLY CHECK

(1) Turn on 1090A/AR, test oscilloscope, and signal generator for a 15-minute warm-up period.

(2) Set the 1090A/AR and 93A controls as follows:

NON INVERT: Pressed
NUMERICS: OFF
MEMORY: ALL
AUTOCENTER: OFF
DISPLAY: Y/T
VERTICAL EXPANSION: OFF
HORIZONTAL EXPANSION: OFF
SWEEP TIME: ×0.5, 1 MICROSEC
TRIGGER: EXT, DC, +
RETAIN REFERENCE: OFF

NOTE: Channel A and Channel B of the 93A plug-in are aligned separately. Either a C amplifier or a D amplifier may be installed in either channel. The only difference is that when a D amplifier is used, the - Channel is always set to GND and only the + Channel is set to NORMAL.

(The following settings refer to the C or D amplifier in Channel A:)

FILTER: 0.5 MHz
RANGE: 1
GND/NORMAL: NORMAL
ON/OFF: ON

(3) Set ON/OFF switch on C or D amplifier in Channel B to OFF.

NOTE: -25 vdc must be checked and adjusted first since other voltages are referenced to it.

(4) Use dc voltmeter to check for -25 (±0.15) vdc at test point indicated in Figure 7. This is on bottom of mother board on Model 93A plug-in. If not within specified range, adjust pot indicated.

(5) Use dc voltmeter to check for +25 (±0.15) vdc at test point indicated in Figure 7. If not within specified range, adjust pot indicated.

(6) Use dc voltmeter to check for +9.5 (±0.3) vdc at test point indicated on Figure 7. If not within specified range, adjust pot indicated.

(7) Turn off the 1090A/AR.

(8) Re-install the 93A plug-in into the main frame.

(9) Turn the 1090A/AR main frame upside down for the rest of the alignment procedure.

(10) Turn on the 1090A/AR power. This completes the voltage supply check. You are now ready to begin dc offset adjustments.

Set up test equipment per this diagram:

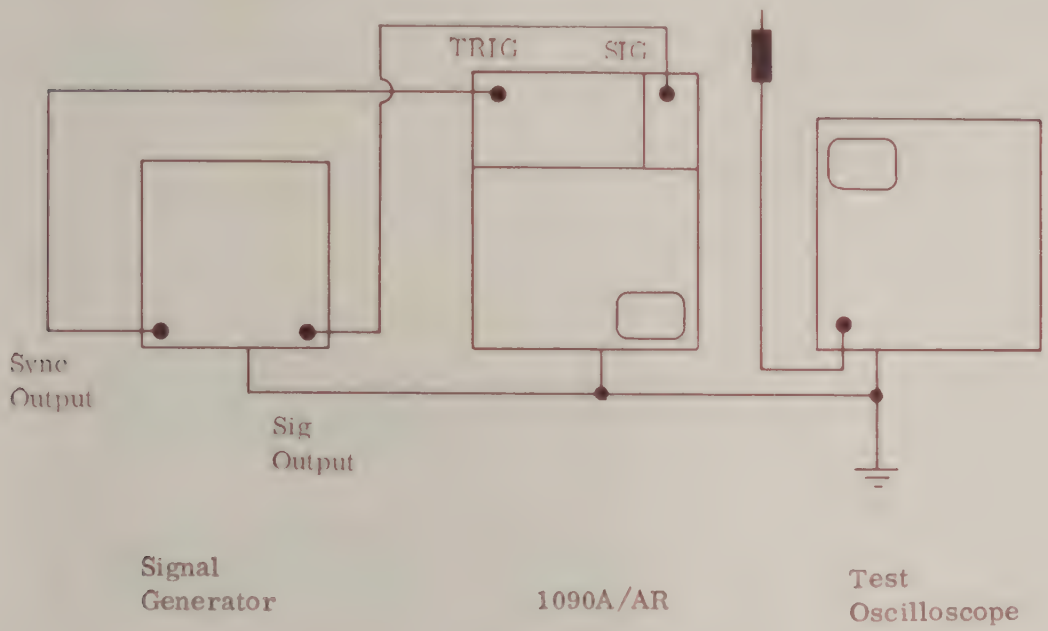


Figure 3. Test Equipment Set-up.

DC OFFSET ADJUSTMENTS

NOTE: Figures 9 through 14 will be referred to during this procedure. Test points E1 through E5 on the Digitizer and Pulser Circuit Boards are tiny loops of wire for ease in attaching the test oscilloscope probe.

NOTE: This procedure, steps 11 through 36, aligns Channel A only. It must be repeated with Channel A turned off and Channel B turned on in order to align Channel B. During repetition, change all Channel A references to Channel B.

(11) Recheck test set-up to assure a common ground between 1090A/AR, test oscilloscope, and signal generator.

(12) Adjust signal generator for a 500 Hz triangular wave which is nearly full scale on the 1090A/AR CRT but assure that the waveform is not

saturating at the top or bottom of the CRT (See Figure 8). Adjust TRIGGER THRESHOLD on 93A plug-in for a stable display.

(13) Adjust test oscilloscope as follows:

(a) Use External Synchronization from synchronization point (wire loop) shown on Pulser Circuit Board. (See Figures 14 and 15.) Synch point is pin 5 of micrologic #5.

(b) Set Time per Division to 0.2 ms/cm.

(c) Set Volts per Division to 1 volt/cm.

(d) Trigger on negative slope.

(14) Connect test oscilloscope probe to Test Point E1 on Channel A Digitizer Board (See Figures 4 and 9) and adjust dc offset R1 so that lower ends of waveform slopes on test oscilloscope are +1.75 volts above ground (See Figure 11).

(15) Connect test oscilloscope probe to Test Point E2 on Channel A Digitizer Circuit Board (See Figures 4 and 9) and adjust dc offset R2 so that lower end of waveform slopes on test oscilloscope are +1.75 volts above ground (See Figure 12).

(16) Connect test oscilloscope to Test Point E3 on Channel A Digitizer Circuit Board (See Figures 4 and 9) and adjust dc offset R3 so that lower ends of waveform slopes on test oscilloscope are +1.75 volts above ground (See Figure 13).

(17) Set Channel A plug-in RANGE switch to a position at least three settings higher than it is now to improve viewing of slopes on Test Point E4.

(18) Connect test oscilloscope probe to Test Point E4 on Channel A Digitizer Circuit Board (See Figures 4 and 9) and adjust dc offset R4 so that lower ends of waveform slopes on test oscilloscope are +1.75 volts above ground (See Figure 13).

NOTE: Test Point and dc offset adjustment for step 19 are on Pulser Circuit Board.

(19) Connect test oscilloscope probe to Test Point E5A on Pulser Circuit Board (See Figure 14 and be sure to choose the proper #5 Test Point). Adjust dc offset R5A on Pulser Circuit Board (See Figure 16 and be sure to choose proper R5A) so that lower ends of waveform slopes on test oscilloscope are +1.75 volts above ground (See Figure 13).

NOTE: This completes DC Offset Adjustments for Channel A. You may now proceed to Adjustment of Stage Output of Test Point E3 and D/A Adjustments.

ADJUSTMENT OF STAGE OUTPUT OF TEST POINT E3

NOTE: This procedure is designed to check that the ADC is monotonic through its full range.

(20) Set VERTICAL EXPAND on 1090A/AR main frame to ON and x64.

(21) Set AUTOCENTER to ON.

(22) Set Channel A RANGE Selector on 83A plug-in to successively higher ranges until the triangular wave is displayed on the 1090A/AR CRT without flattening at the top or bottom of the CRT (Refer to Figure 18).

NOTE: HORIZONTAL POSITION control on 1090A/AR main frame may be used to center triangular waveform on CRT. Signal generator output and HORIZONTAL POSITION control adjustment may also be required to accomplish nearly full scale triangular waveform display.

(23) Determine if stage output of E3 is misaligned by slowly rotating the Channel A OFFSET control through its range. If there are separations every 64 ADC levels (each ADC level is one of the discrete, horizontal lines making up the waveform on the 64x vertical expansion) R6 requires adjustment. Adjust R6 (Refer to its location on Channel A Digitizer Circuit Board Figure 9) until the 1090A/AR CRT display shown in Figure 19 is achieved. The ADC levels should be aligned in a straight line along both sides of the triangular waveform when R6 is properly adjusted.

D/A ADJUSTMENT

NOTE: There are seven D/A pots that will be adjusted. The best way to adjust the D/A settings is to begin by deliberately misaligning all of them fully clockwise. This step will help verify that you are adjusting the proper pot in future steps.

(24) Turn R7, R8, R9, R10, R11, R12, and R13 (See Channel A Digitizer Circuit Board Figures 9 and 17) fully clockwise from their present settings.

(25) Refer to Figure 19 and note the relationship between the various D/A levels and their adjustment pots. The three major D/A levels are D/A #1, D/A #2, and D/A #3 adjusted, respectively, by R11, R12, and R13. The four minor D/A levels are adjusted by R7, R8, R9, and R10.

(26) Rotate the Channel A OFFSET adjustment fully counterclockwise.

NOTE: In steps 27 through 31 adjust the Channel A OFFSET control so that the separation is approximately centered vertically on the 1090A/AR CRT to help make the pot adjustments more accurate.

(27) S-L-O-W-L-Y rotate the Channel A OFFSET control clockwise, noting each separation encountered. After noting three or four small separations, but no more than five, you should find a separation indicating major D/A level #1. Adjust R11 (See Channel A Digitizer Circuit Board Figure 9) until the separation disappears. If adjusting R11 will not affect the separation you have not found D/A level #1. Repeat step 26 and this step.

(28) Continue to S-L-O-W-L-Y rotate the Channel A OFFSET control clockwise until the next separation is approximately centered vertically. Adjust R7 (See Channel A Digitizer Circuit Board Figure 17) until the separation disappears.

(29) Continue to S-L-O-W-L-Y rotate the Channel A OFFSET control clockwise until the next separation is approximately centered vertically. Adjust R8 (Figure 17) until the separation disappears.

(30) Continue to S-L-O-W-L-Y rotate the Channel A OFFSET control clockwise until the next separation is approximately centered vertically. Adjust R9 (Figure 17) until the separation disappears.

(31) Continue to S-L-O-W-L-Y rotate the Channel A OFFSET control clockwise until the next separation is approximately centered vertically. Adjust R10 (Figure 17) until the separation disappears.

NOTE: This completes adjustment of the minor D/A levels. Once these have been adjusted between two major levels they are in calibration for all locations.

(32) Return Channel A OFFSET control to its fully counter-clockwise position to begin the major D/A level adjustments.

(33) Slowly adjust Channel A OFFSET control clockwise to the first separation (D/A level #1). Adjust R11 (See Channel A Digitizer Circuit Board Figure 9) until the separation disappears.

(34) Continue adjusting Channel A OFFSET control clockwise to the next separation (D/A level #2). Adjust R12 (Figure 9) until the separation disappears.

(35) Continue adjusting Channel A OFFSET control clockwise until the next separation (D/A level #3) is reached. Adjust R13 (Figure 9) until the separation disappears.

(36) Continue to rotate Channel A OFFSET control slowly to clockwise limit, then rotate it slowly fully counter-clockwise, checking for separations and glitches. None should be found and this verifies that the D/A's are properly adjusted.

NOTE: D/A adjustments may affect DC Offset adjustments. At this point repeat steps 11 through 19 to recheck the DC Offset adjustments and make any slight adjustments required to take care of any glitches noted. The frequency with which the glitches occur in the ADC will give the clue as to which offset requires adjustment. The following list will help determine the proper adjustment:

Number of ADC Levels Between Glitches	Adjustment Required
4	R5
16	R4
64	R3
256	R2
1024	R1

Some trial and error in adjusting may be required and experience will eventually dictate the proper adjustment for the glitches noted. This should complete the alignment procedure. If the ADC has glitches or separations which can't be adjusted out, then another problem must exist.

NOTE: This completes the procedure for alignment of Channel A of the 93A plug-in. To align Channel B perform step 37.

(37) To align Channel B, repeat steps 1 through 3, and 11 through 36 except change all Channel A references to Channel B. Be sure to make pot

adjustments on the Channel B Digitizer Circuit Board (See Figure 4) and the Channel B portion of the Pulser Circuit Board (Figure 14).

TROUBLESHOOTING AIDS

NOTE: Refer to marked-up schematic diagrams, Figures 10 and 15, during this discussion of troubleshooting.

Emitter-Follower Stage Biasing

Any number of component failures related to the dc operating point of the amplifiers, the discriminators, or the D/A's may cause glitches. Refer to Figure 20 for an example of a biasing-related problem. In looking for the source of such a problem view E1 through E5 looking for waveforms that have slopes going below +1 volt or above +7 volts. Since there are no adjustable pots for the bias you must change fixed 8.2K and 15K resistors (See Figure 10) if there is a bias problem.

RE Pulse Clamping

An important part of each stage is the RE pulse clamp (See Figure 10). This transistor will insure that the stage always begins a conversion at ground potential. A problem in this area will cause glitches. To check for proper RE pulse clamp operation, view E1 through E5 with the test oscilloscope set up to look at a single conversion cycle (Refer to Figure 21.) The clamp time will increase in length with each succeeding stage.

Additional Separation Problems

Additional separations in the ADC may be caused by a slight change occurring in the gain of any of the E4 or E5 amplifier stages. Here again the frequency at which these separations appear throughout the ADC will give a clue as to the stage causing them. The E4 stage causes separations to occur approximately every 16 levels. The E5 stage causes separations approximately every 4 levels.

There are no adjustable pots to compensate for this problem. The stage gain in question will have to be changed by adding resistance to (in series) or shunting the 1K feedback resistors in the amplifiers.

The D/A converters may also be a source of separation problems (See Figure 22). Each diode island in a D/A converter must have characteristics nearly identical to the other islands in the converter. If one island is different, perhaps due to a leaky diode, a separation will result. If changing a stage gain will cause the original

separation to disappear but others to appear the problem is related to a particular island in the D/A converter. That island will be in the D/A converter just preceding the stage where the gain was changed.

WHEN ALL ELSE FAILS

In the case of problems beyond the scope of this alignment procedure, TWX or telephone the 1090A Service Department at Nicolet Instrument Corporation. The TWX number is 910-286-2713, and the telephone number is (608) 271-3333.

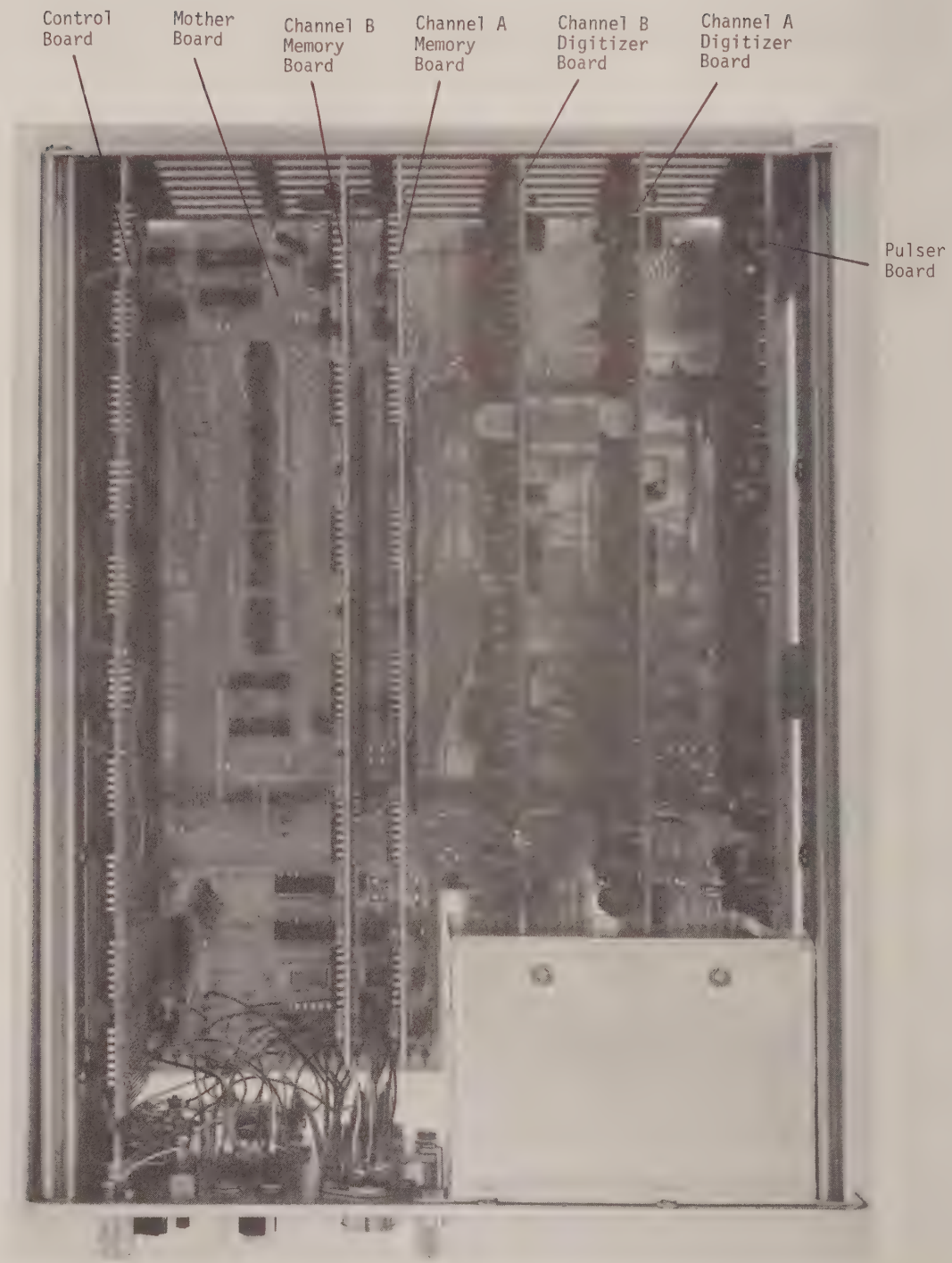


Figure 4. Bottom View of 93A Plug-In Showing Circuit Board Locations.

Figure 5A. (1090A/AR Display)

Figure 5B. (1090A/AR Display)

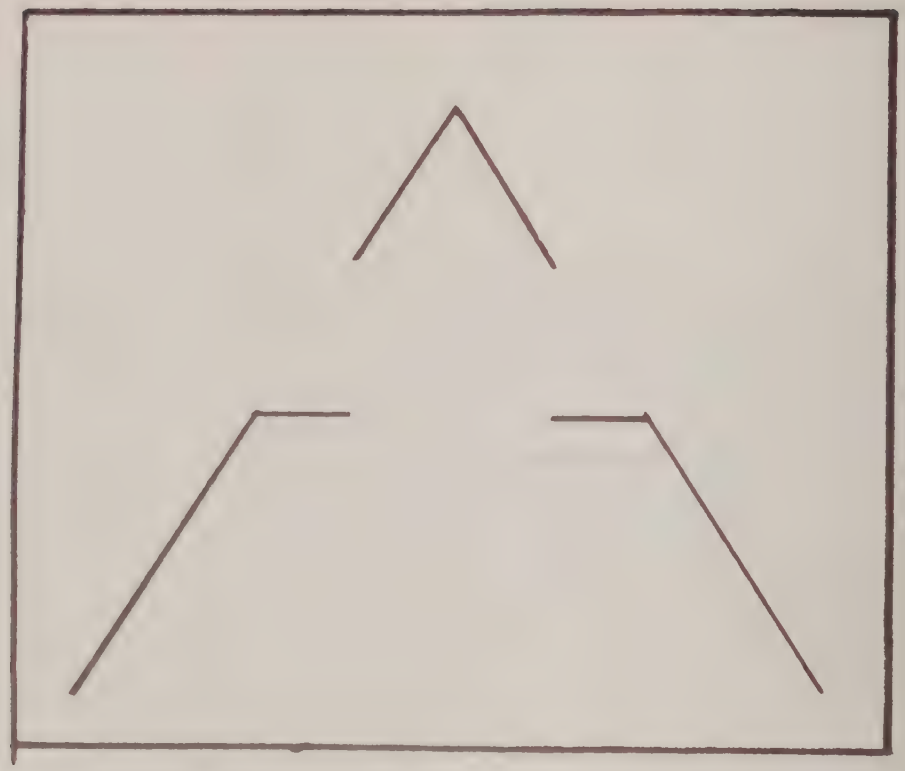


Figure 6A. (1090A/AR Display)

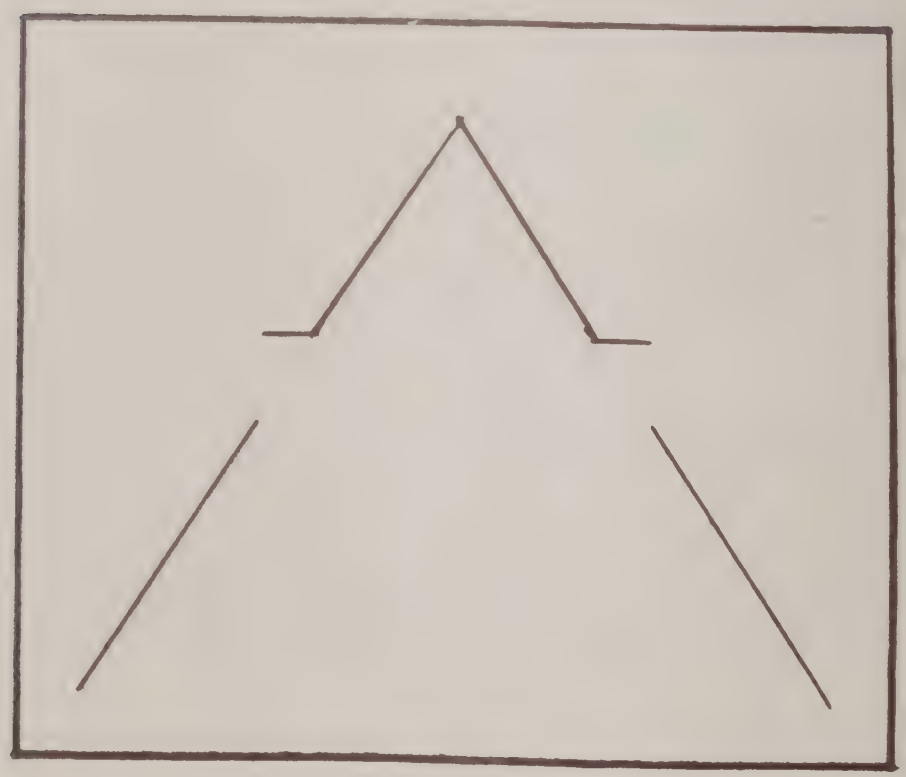


Figure 6B. (1090A/AR Display)

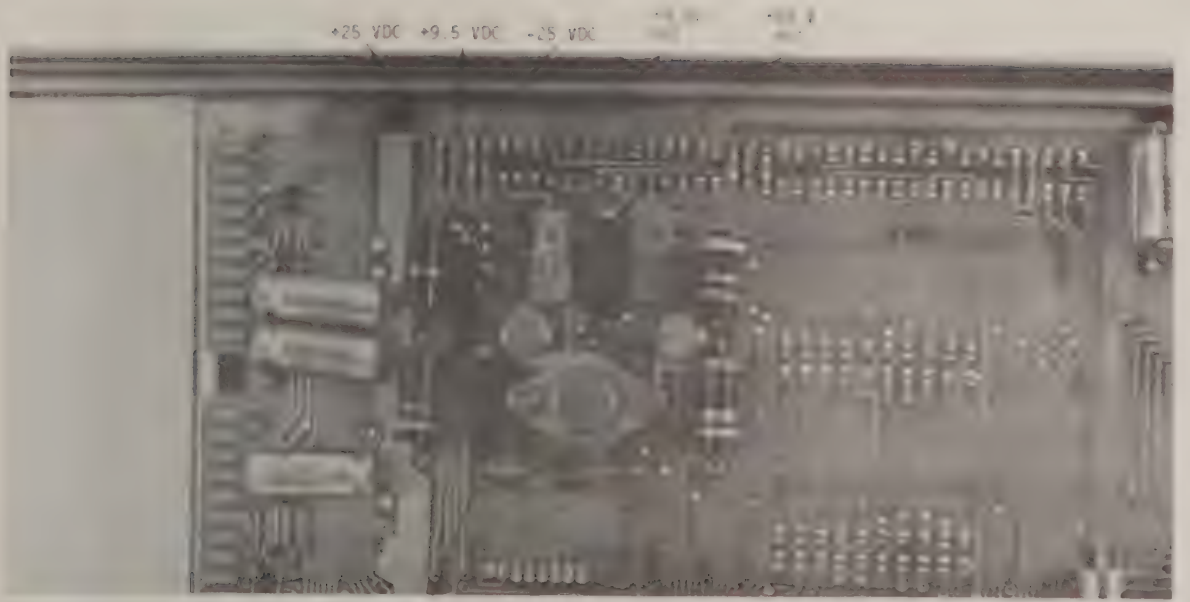


Figure 7. Location of Voltage Supply Test Points and Adjustments

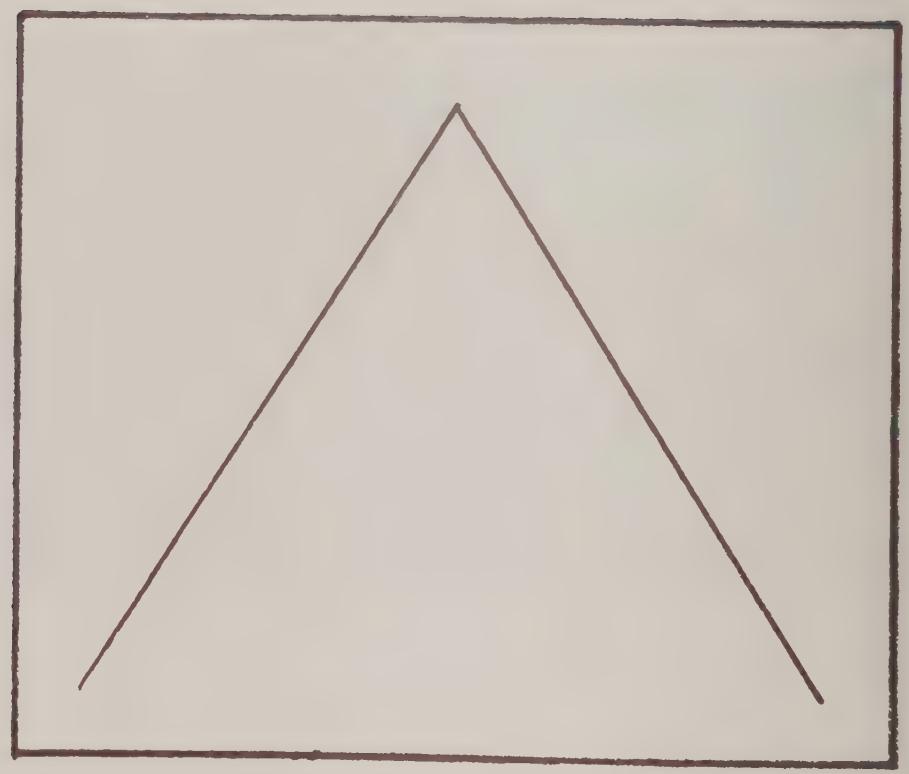


Figure 8. (1090A/AR Display)

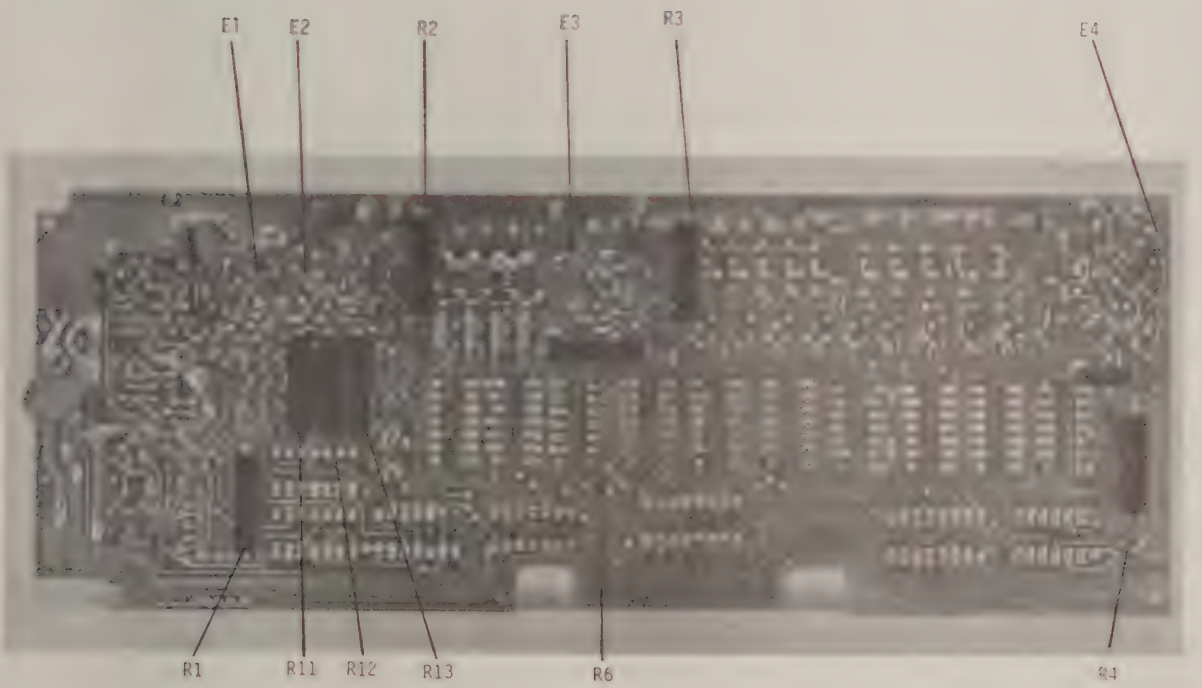
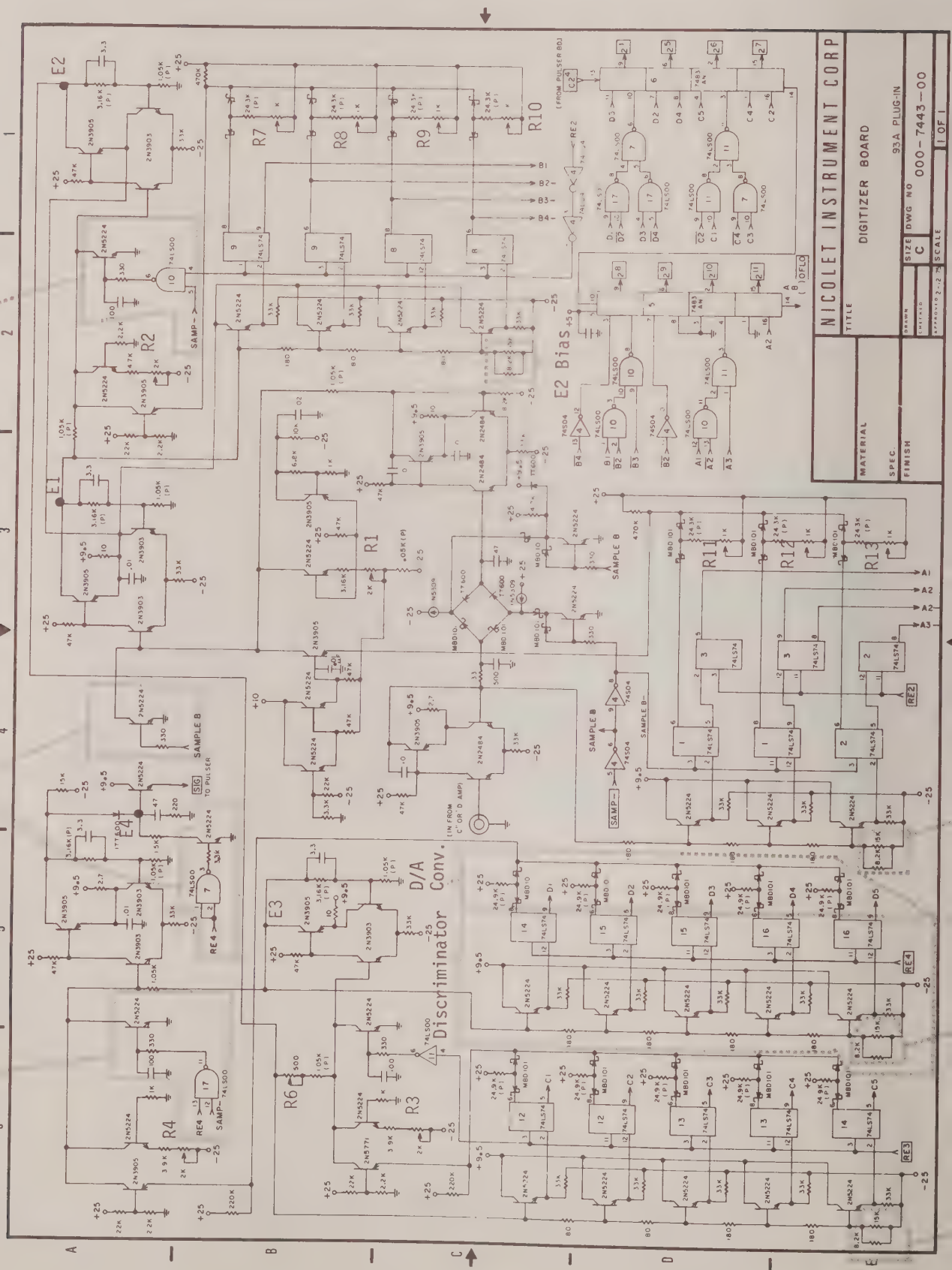


Figure 9. Test Points and Adjustments on Fast Digitizer Circuit Board (Side 1)

Figure 10. Schematic Diagram of Fast Digitizer Circuit Board



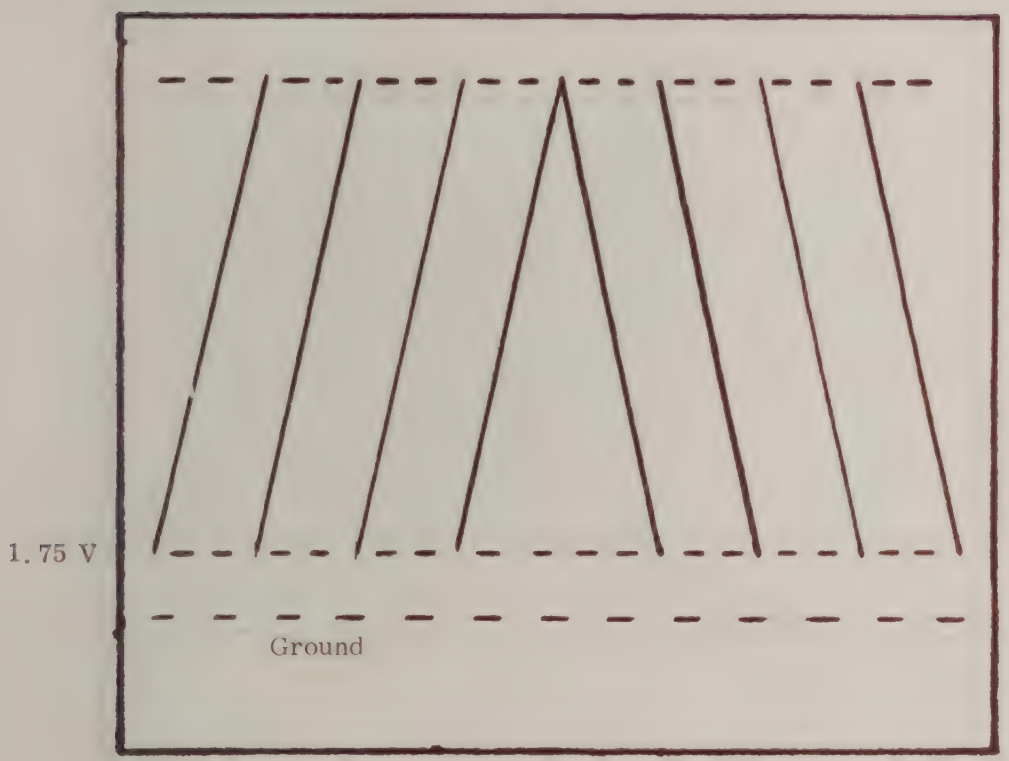


Figure 11. (Test Oscilloscope)

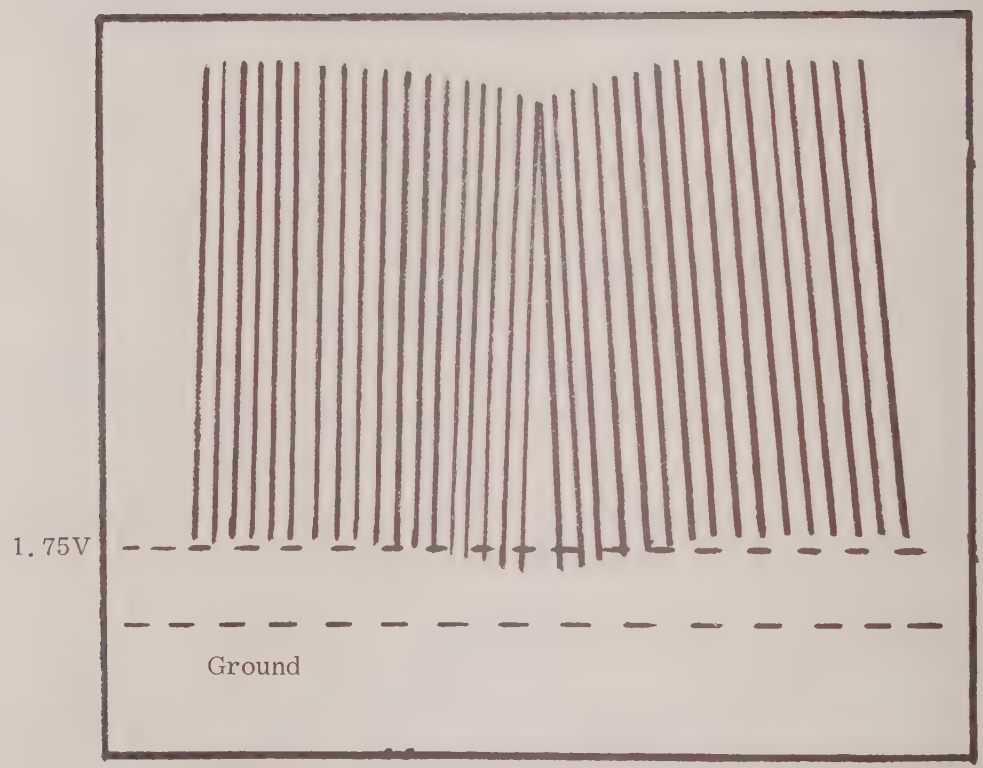


Figure 12. (Test Oscilloscope)

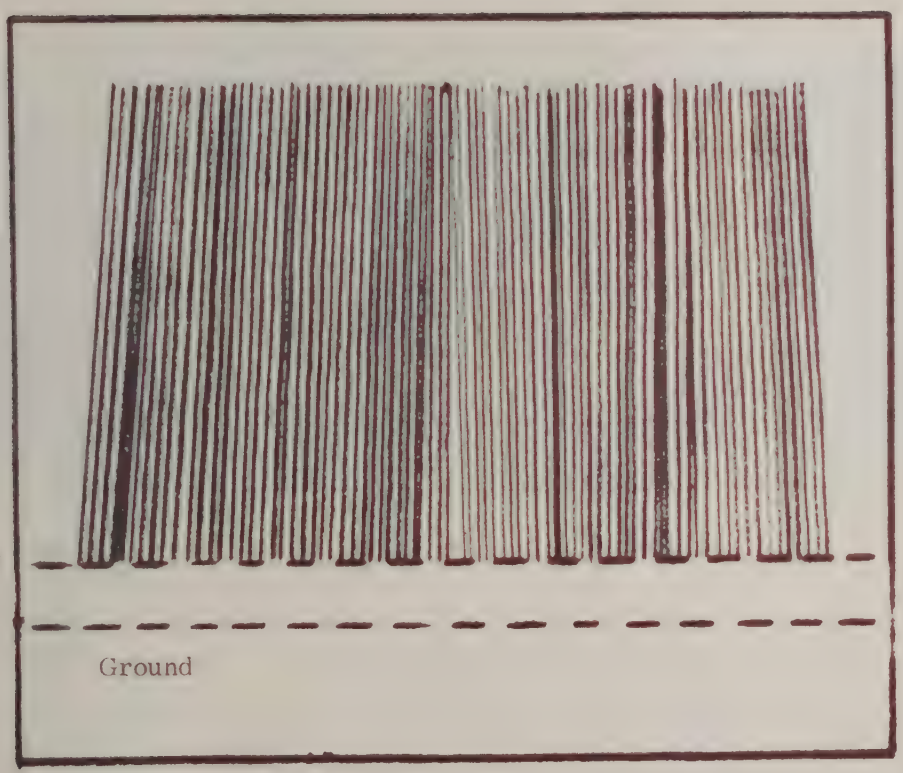


Figure 13. (Test Oscilloscope)

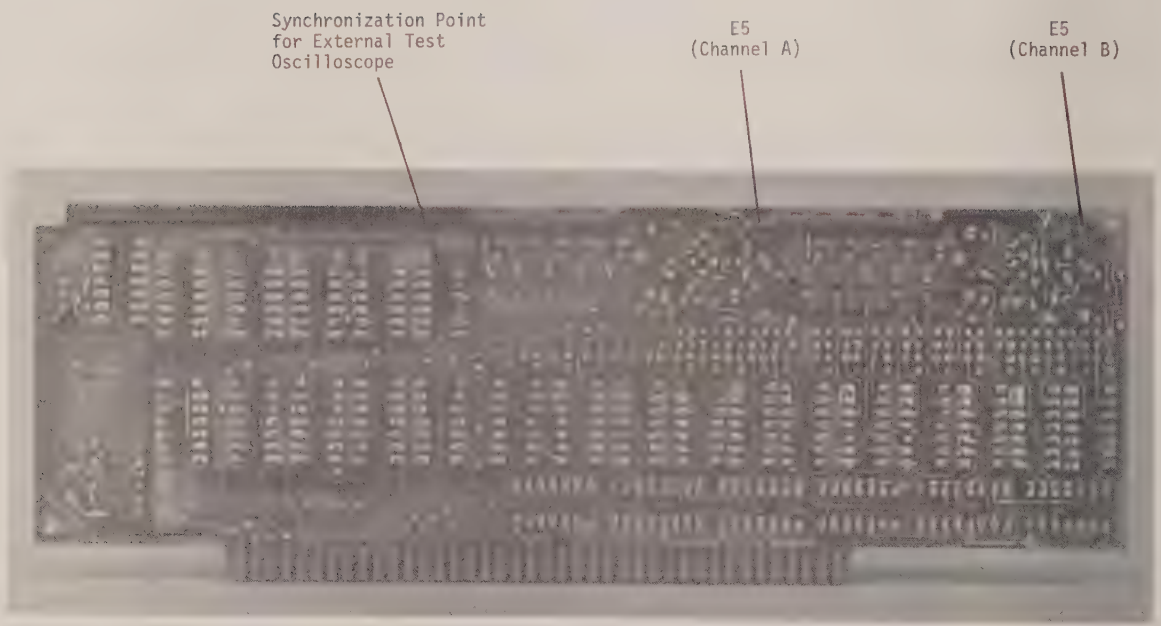
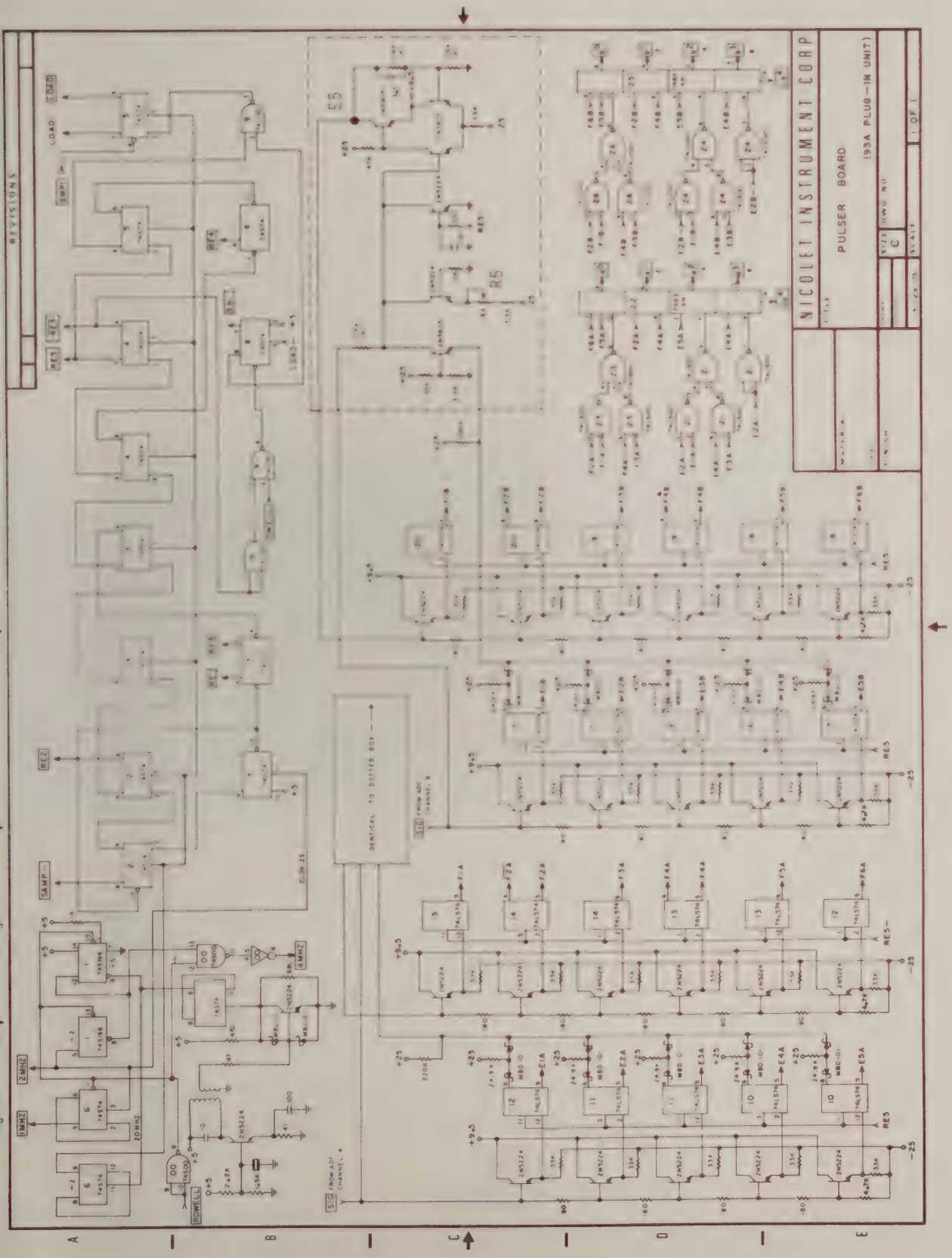


Figure 14. Test Points and Adjustments on Pulser Circuit Board (Side 1)

Figure 15. Schematic Diagram of Pulser Circuit Board



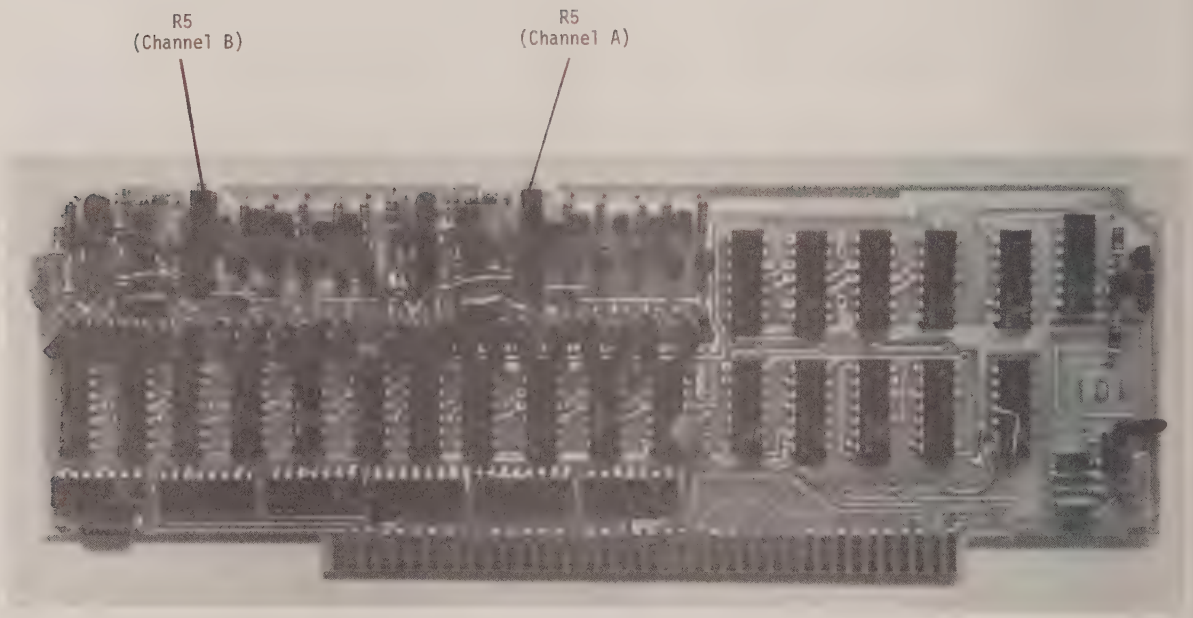


Figure 16. Adjustments on Pulser Circuit Board (Side 2)

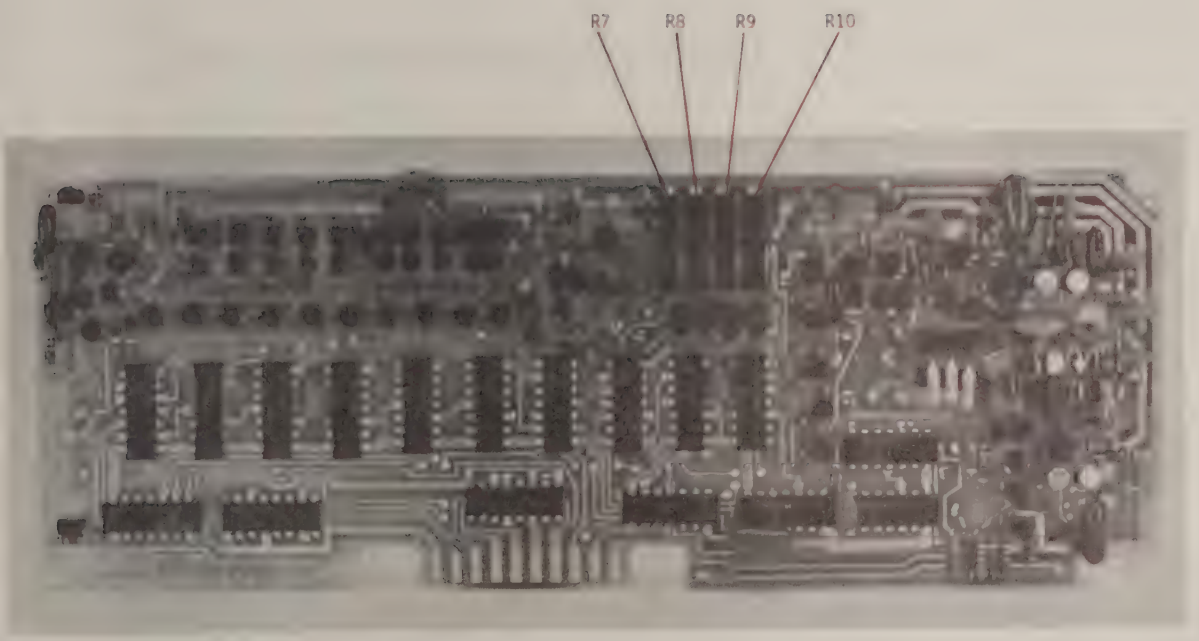


Figure 17. Adjustments on Fast Digitizer Circuit Board (Side 2)

Figure 18. (1090A/AR Display)

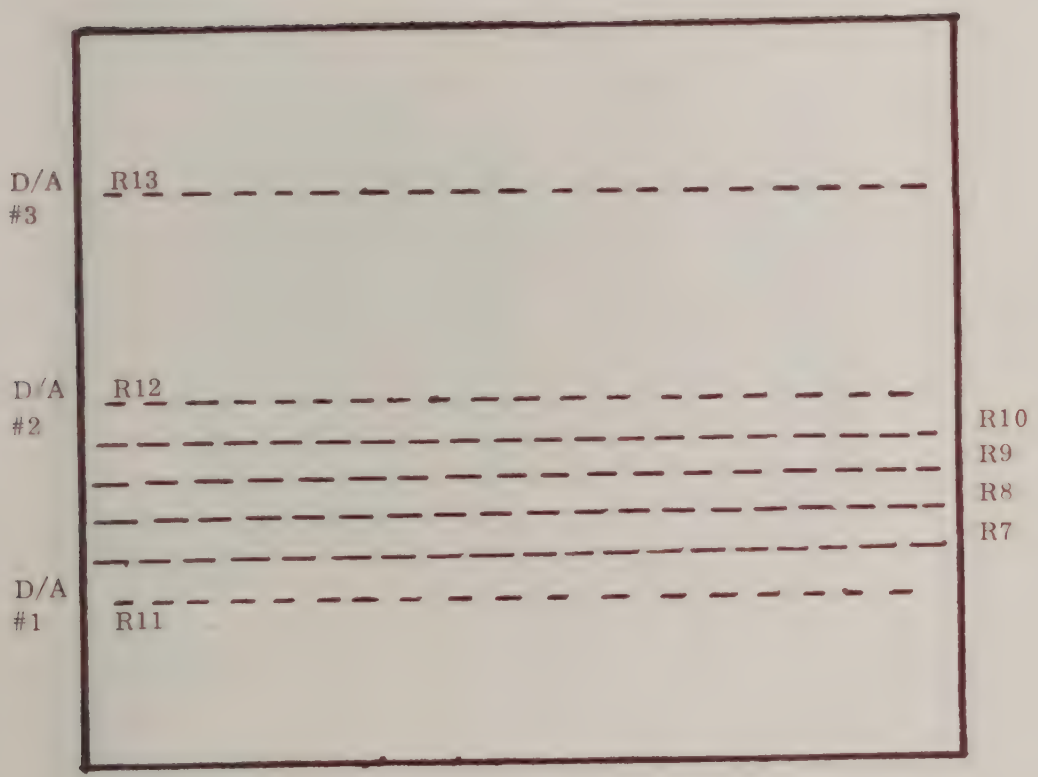


Figure 19. (1090A/AR Display)

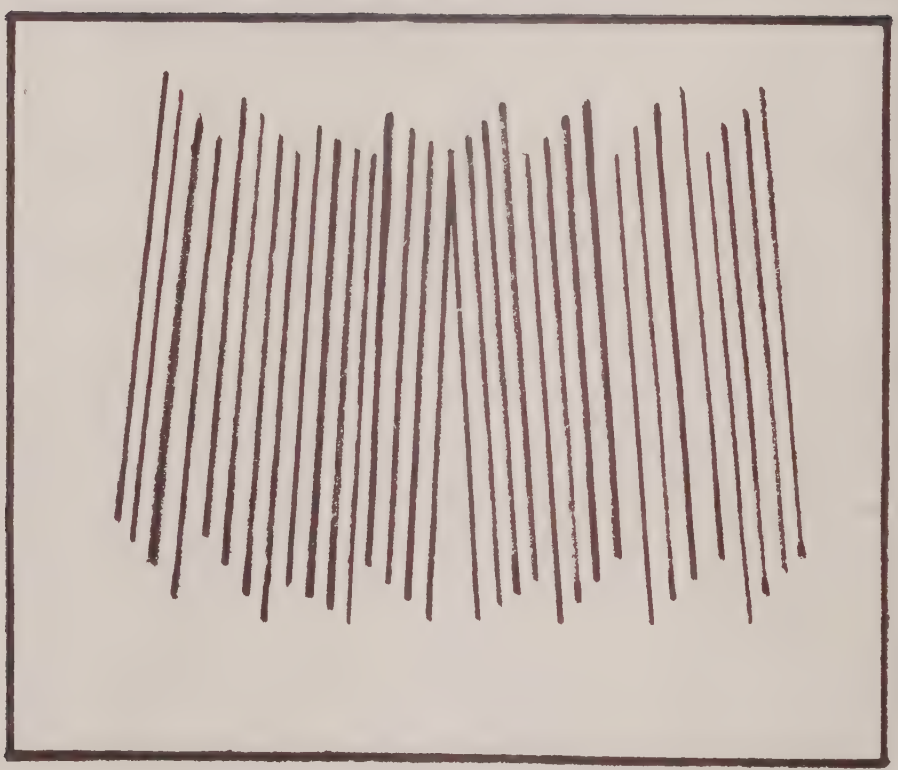


Figure 20. (Test Oscilloscope)

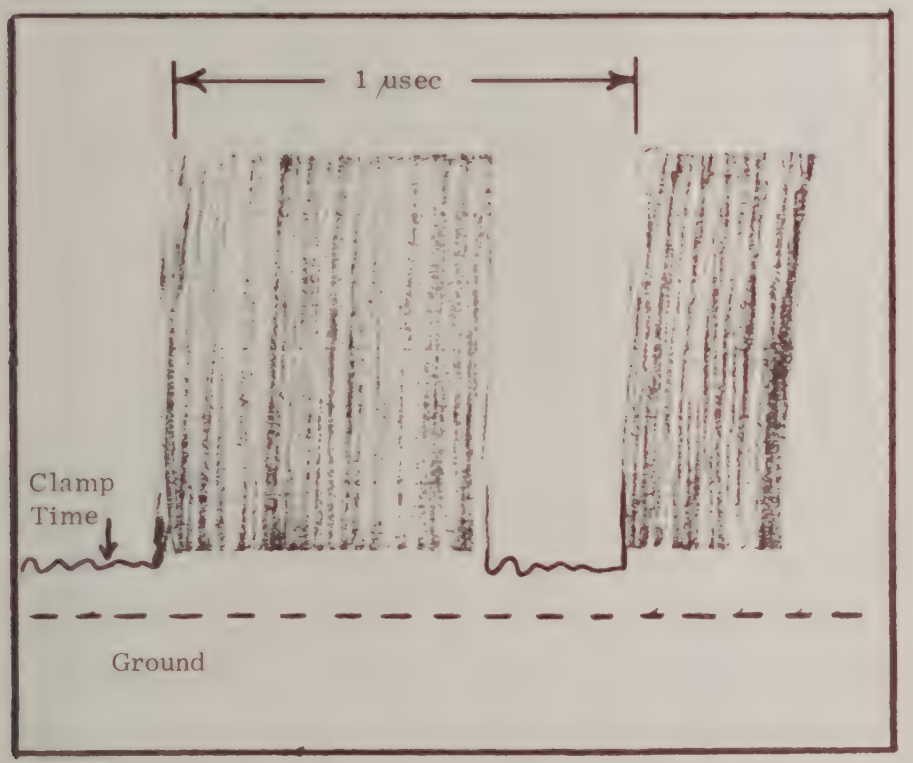


Figure 21. (Test Oscilloscope)

Figure 22. (Test Oscilloscope)

DESCRIPTION OF POWER CONVERTER OPERATION

The basic power converter consists of an inductor and a switch (See Figure 1).

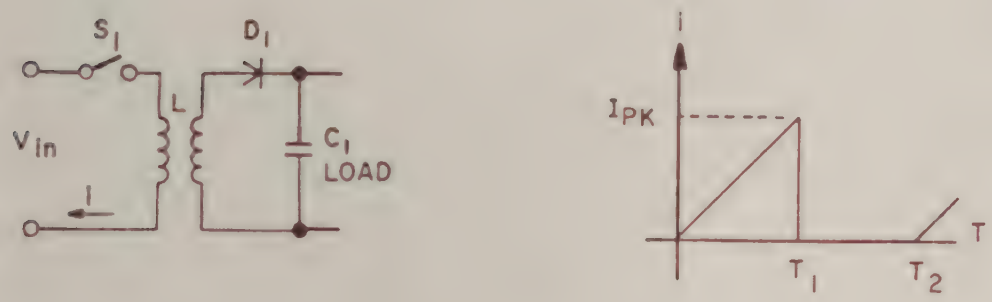


Figure 1

Since $E = L\frac{di}{dt}$ it can be seen that given a constant voltage V_{in} and a fixed inductance L, i will be a current ramp upon closing S_1. At time t_1, a current equal to I_{PK}^2 will be flowing through the inductor L. If S_1 is opened at t_1, energy equal to $1/2\ L\ I_{PK}^2$ will be stored in L. Since i cannot stop flowing instantaneously, a back emf is produced thus turning on diode D_1 and allowing the energy stored in L to be transferred to C_1 or the output.

At time t_2 the cycle repeats itself. Thus it can be seen that power will be transferred through the transformer at a rate determined by (energy stored per cycle × the frequency = power).

By controlling I_{PK} or the frequency a constant Vout may be obtained for various output power requirements. The switch S_1 is a transistor with high Vceo and good secondary breakdown characteristics. Most of the circuitry within the converter supply is used to control this transistor switch. Each segment of the converter will be discussed in detail. Figure 2 shows the complete converter supply in block diagram form along with waveforms of various points within the circuit.

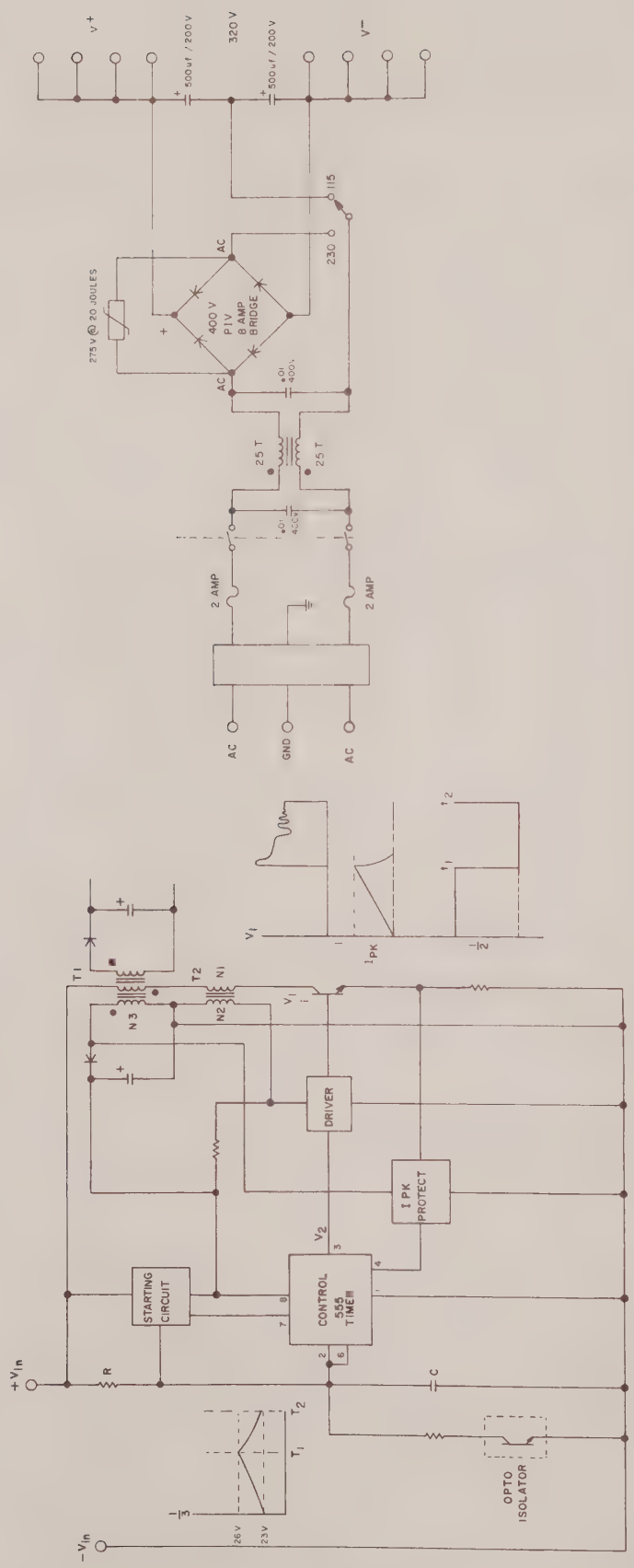

V+
500uf / 200V
320 V
500uf / 200V
V−
115
230
AC
400 V
PIV
8 AMP
BRIDGE
275 V @ 20 JOULES
.01
400V
25 T
25 T
2 AMP
2 AMP
AC
GND
AC
T1
T2
N1
N2
N3
DRIVER
1 PK
PROTECT
CONTROL
555
TIMER
STARTING
CIRCUIT
R
C
OPTO
ISOLATOR
26 V
23 V

Figure 2

The rectifier and filter consists of a bridge rectifier and a filter capacitor used to rectify and filter the AC from the power line (See Figure 3). The DC output voltage of the filter will range from 125V DC to 380V DC depending upon the input AC voltage. A technique for effectively doubling the 115V input voltage may also be employed. If this is the case, the DC output will be 250V DC to 380V DC but a 115-230 switch is required in this case.

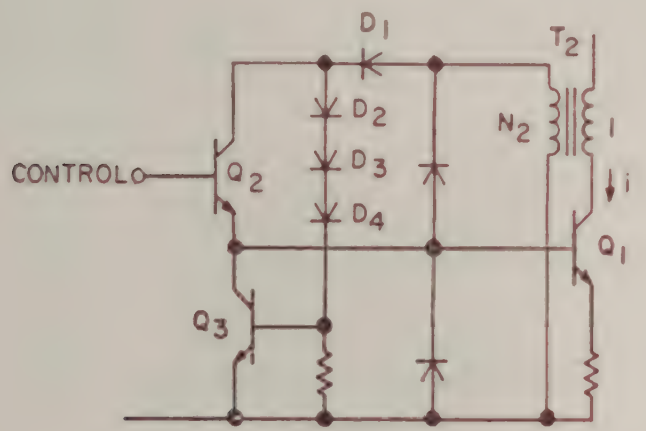


Figure 3

Transformers and Transistor Switch (Refer to Figure 2)

The power transformer T_1 is a toroid tightly wound for maximum primary-to-secondary coupling. Energy is stored in T_1 when the transistor switch is on. When the transistor is turned off, the energy stored in T_1 is dumped into the secondary circuit as explained earlier. Transformer T_2 is a current drive transformer with a winding ratio $\frac{N_2}{N_1} = 2$. This transformer provides current drive for Q_1. The transistor used for Q_1 has a very low H_{FE} thus T_2 is used to force a beta of 2 by the relationship. $N_1 i = N_2 i_B$. Q_1 is a high voltage transistor with good secondary breakdown characteristics.

The driver is used to provide drive for Q_1 and also for aiding in the turn-off of Q_1. A signal from the control allows Q_2 to turn on thus turning on Q_1. Q_2 controls the current from transformer T_2. At a point determined by the control, Q_2 turns off thus beginning the turn-off of Q_1. Since Q_1 is slow to turn off, i continues to flow for a short time even after Q_2 is turned off. At that moment transformer T_2 becomes a voltage transformer thus the voltage at N_2 begins to increase until Q_3 turns on through steering diodes D_1 to D_4. When Q_3 turns on a very low impedance path is provided at the base of Q_1. This pulls base current from Q_1 thereby turning Q_1 off more rapidly. Once Q_1 is off, the base is held low until a new cycle is repeated.

Control (See Figure 2)

The control consists of a timer running in an astable mode. The frequency of oscillation and the duty cycle is determined by the input voltage through R and the conductance of the opto isolator. The output of the control provides the necessary drive for the driver circuit. The block labeled I_{PK} PROTECT in Figure 2 is a circuit that signals the control to shut off if the peak current flowing in Q_1 reaches about 3 amps. This prevents Q_1 from entering secondary breakdown.

Since the converter supplies its own power for drive and timing, a method must be used to start the converter initially. Two capacitors and a breakdown diode do just this (See Figure 4).

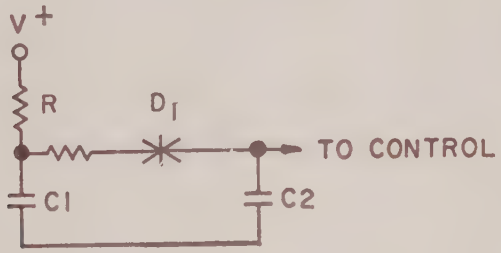


Figure 4

C_1 charges to approximately 30V at which point the diode D_1 (bidirectional trigger) breaks over and dumps the energy on C_1 to C_2. When the voltage of C_2 equals the voltage on C_1 the diode D_1 turns off.

There is enough energy and voltage on C_2 to provide a few milliseconds of operation for the control and the converter. When the converter starts operating the power necessary for operation comes from N_3 of T_1.

Similarly, the opto isolator has no means of operating until the output has voltage available. Thus a starting circuit enables the control to oscillate until the supply voltage on the control reaches approximately 10 volts. At this point the opto isolater feedback system controls the oscillation frequency of the control.

Troubleshooting Hints

Extreme caution must be used when troubleshooting this supply. There is no line transformer, thus the circuitry other than the rectifier output voltage on the

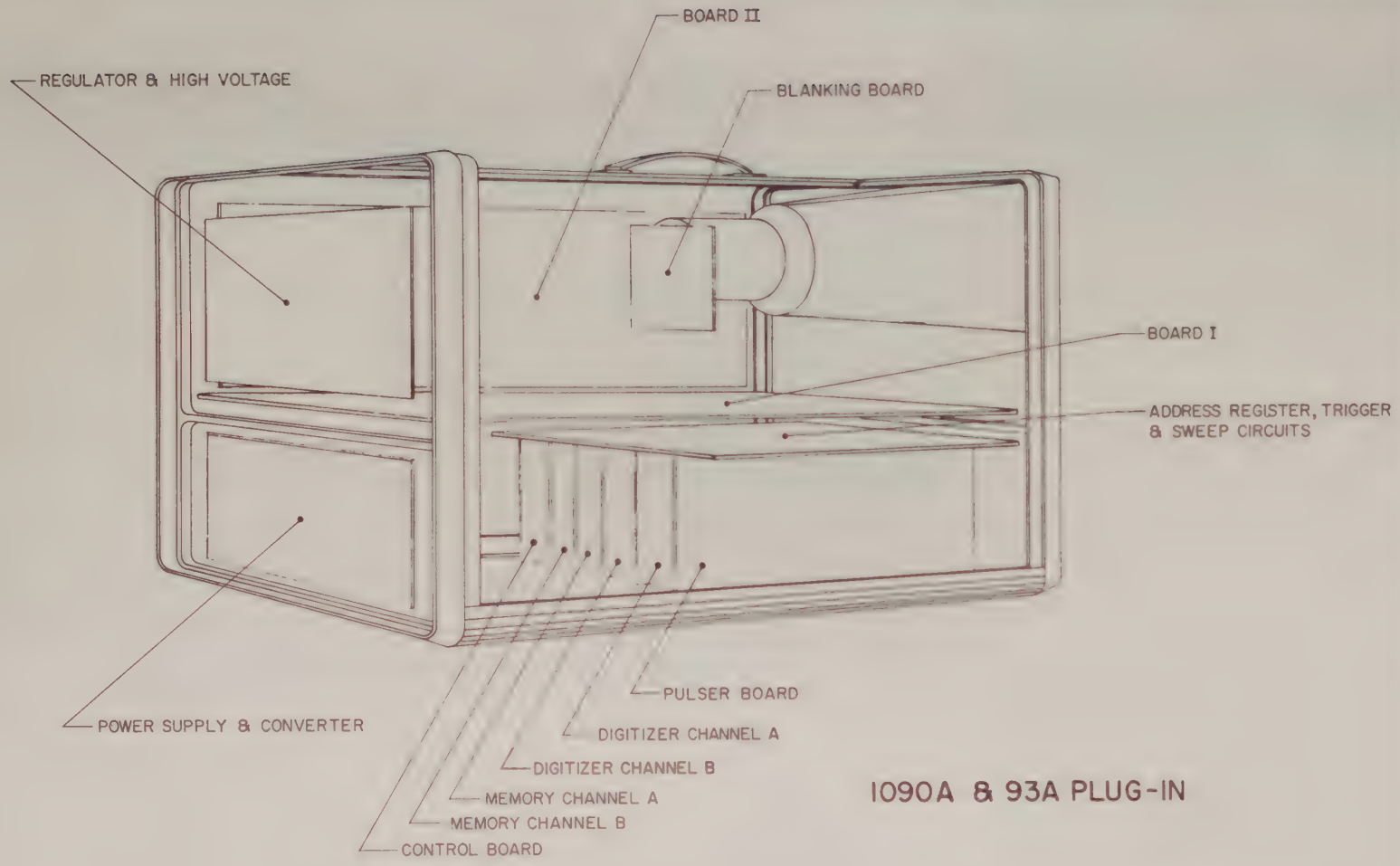
secondary is floating at line potential. Before troubleshooting, be sure the input is isolated through a 1 to 1 isolation transformer rated at a minimum of 150 watts.

Most often, failures will occur in the current switch Q_1. This is a high voltage, high current transistor which, no matter how well protected, can enter a secondary breakdown if certain problems exist elsewhere in the supply. Sometimes when Q_1 shorts, so will Q_3. When troubleshooting, check these two transistors first.

The reason for a failure will most often be a shorted diode in the output of the supply. Check these diodes before turning the supply on after any failure.

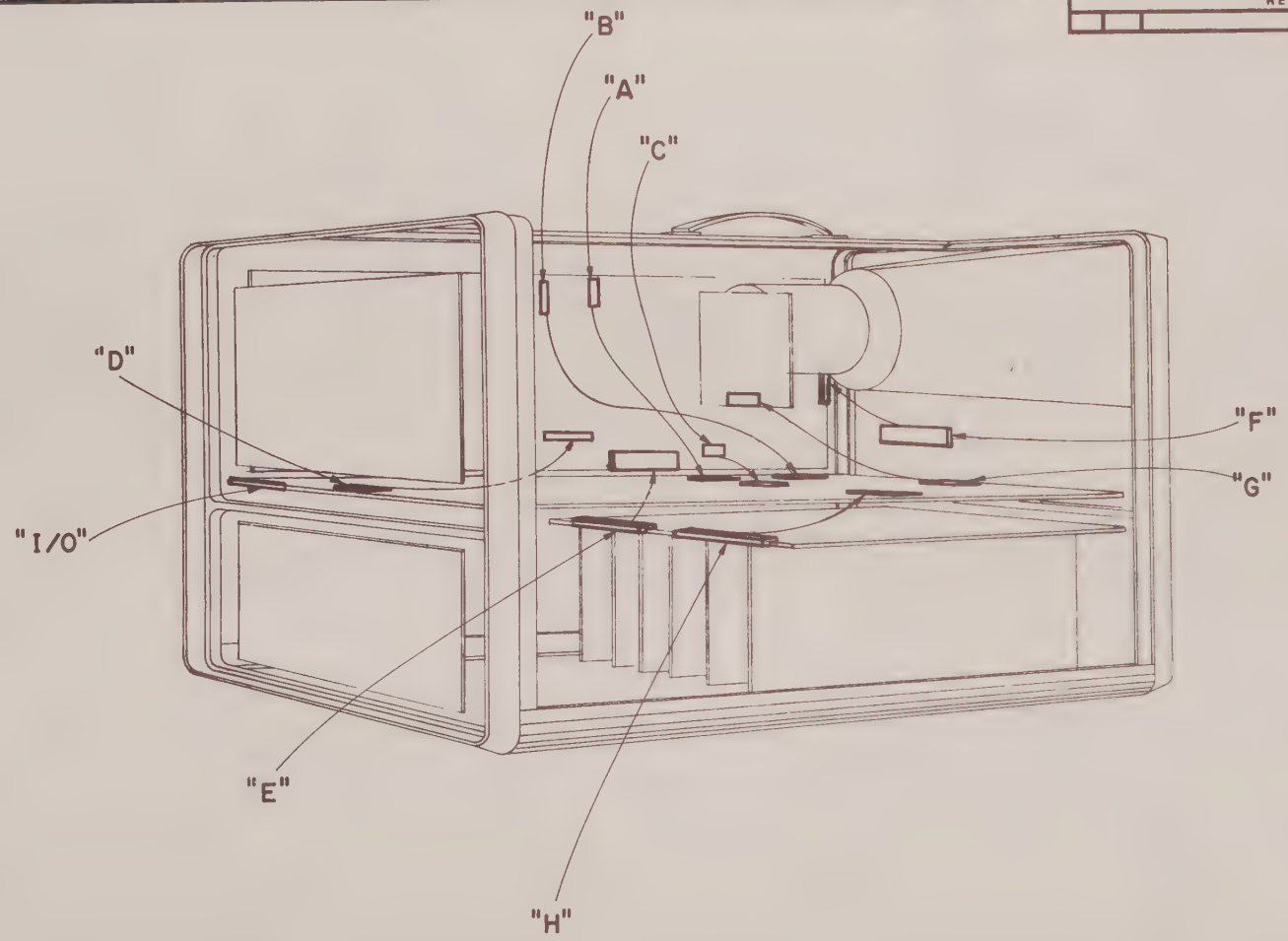
SCHEMATIC DIAGRAMS:

	Page
Board Placement Diagram, 1090A and 93A	57
Connector Location	58
Connector and Board Placement, 1090AR	59
Board Placement Diagram, 94A	60
Model C Amplifier	61
Model D Amplifier	62
1090A Power Supply	63
Board I Model 1090A/AR and Blanking Board	64
Board II Model 1090A/AR and Front Panel	65
Digitizer Board, 93A	66
Memory Boards, 93A	67
Control Board, 93A	68
Pulser Board, 93A	69
Address Register, Trigger and Sweep Circuits, 93A (Sheet 1 of 2)	70
Address Register, Trigger and Sweep Circuits, 93A (Sheet 2 of 2)	71
Mother Board, 94A	72
Digitizer Board, 94A	73
Memory Board, 94A	74



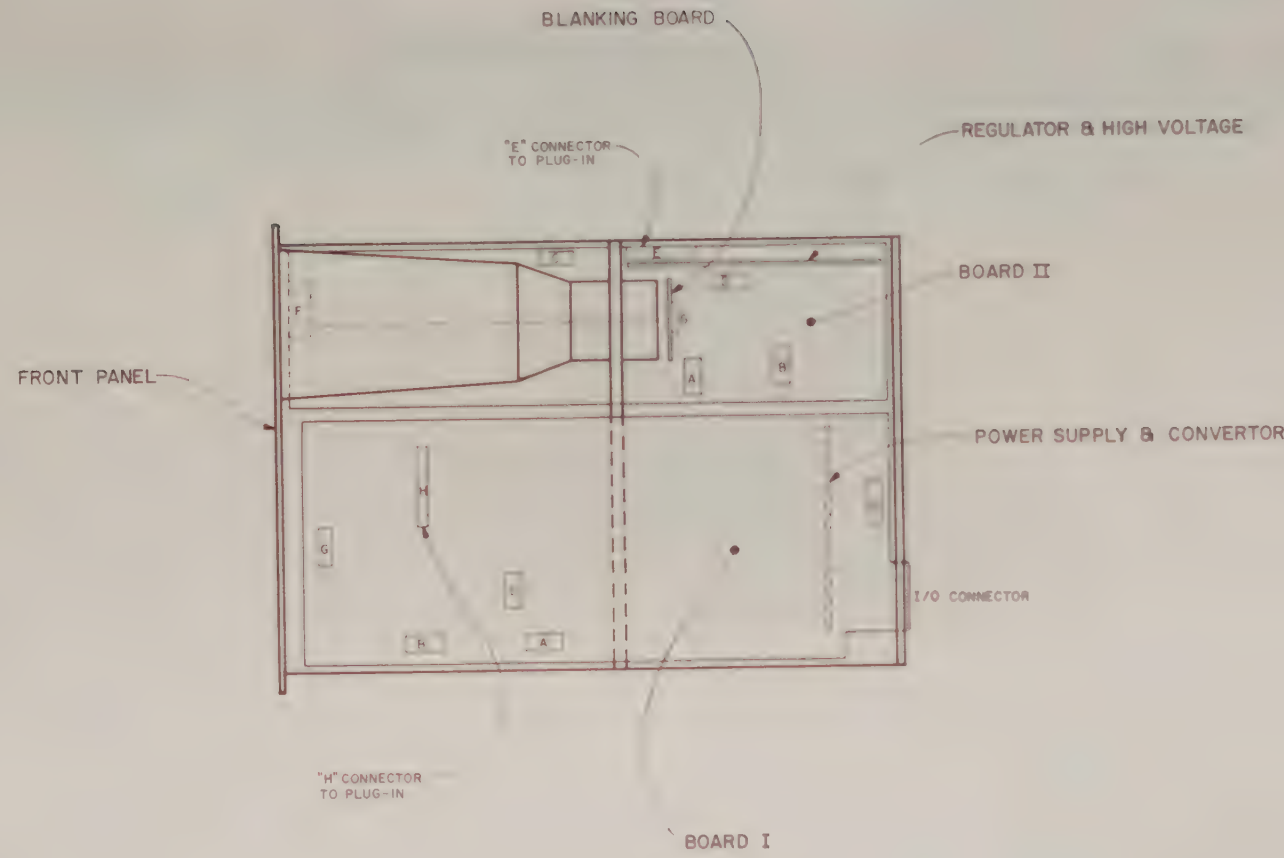
1090A & 93A PLUG-IN

	NICOLET INSTRUMENT CORP
MATERIAL / SPEC	TITLE: BOARD PLACEMENT DIAGRAM
FINISH	SIZE C; DWG NO
	SCALE

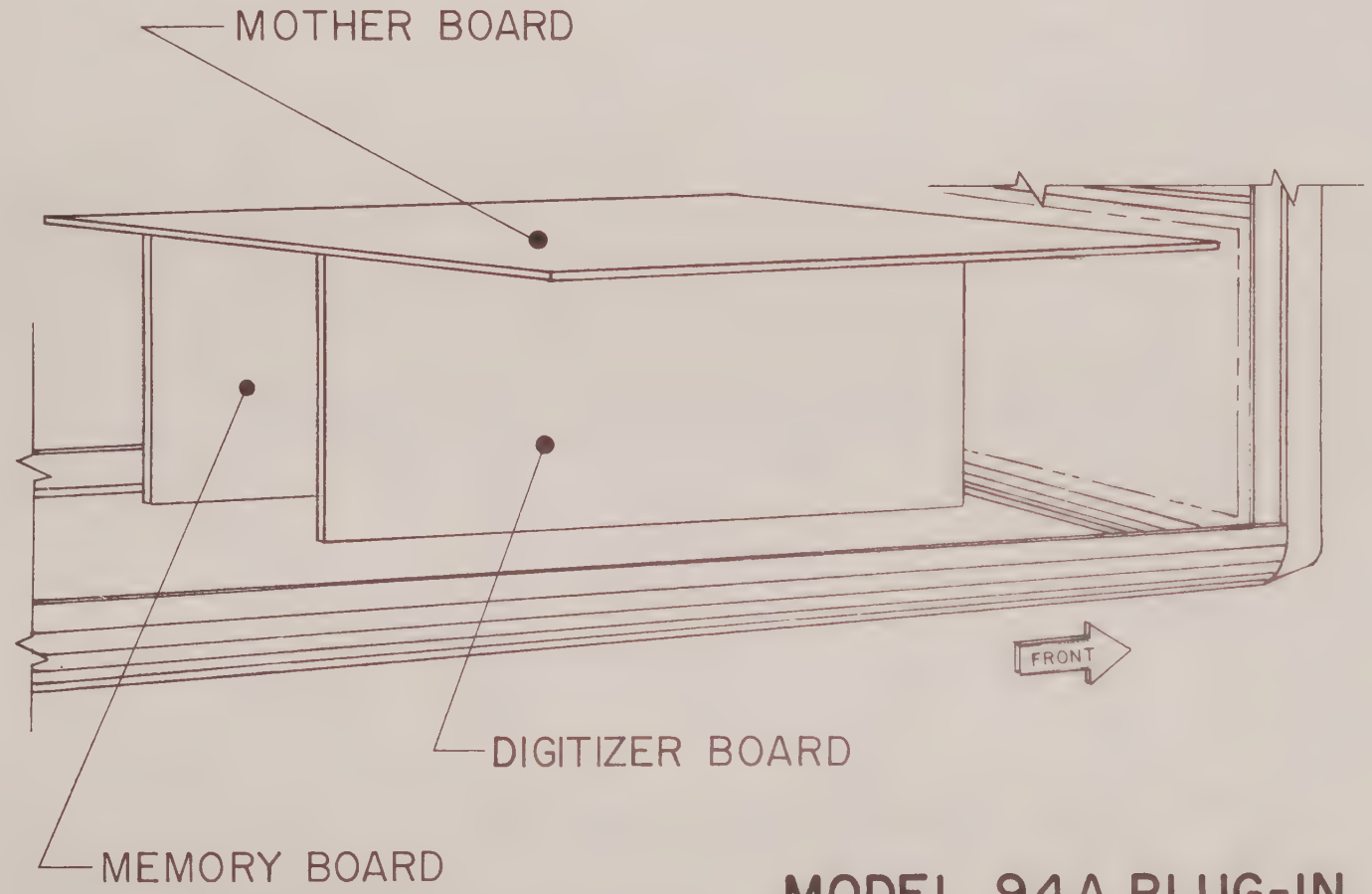


REVISIONS

MATERIAL	NICOLET INSTRUMENT CORP
SPEC	TITLE: CONNECTOR LOCATION
FINISH	SIZE: C; DWG NO
	SCALE

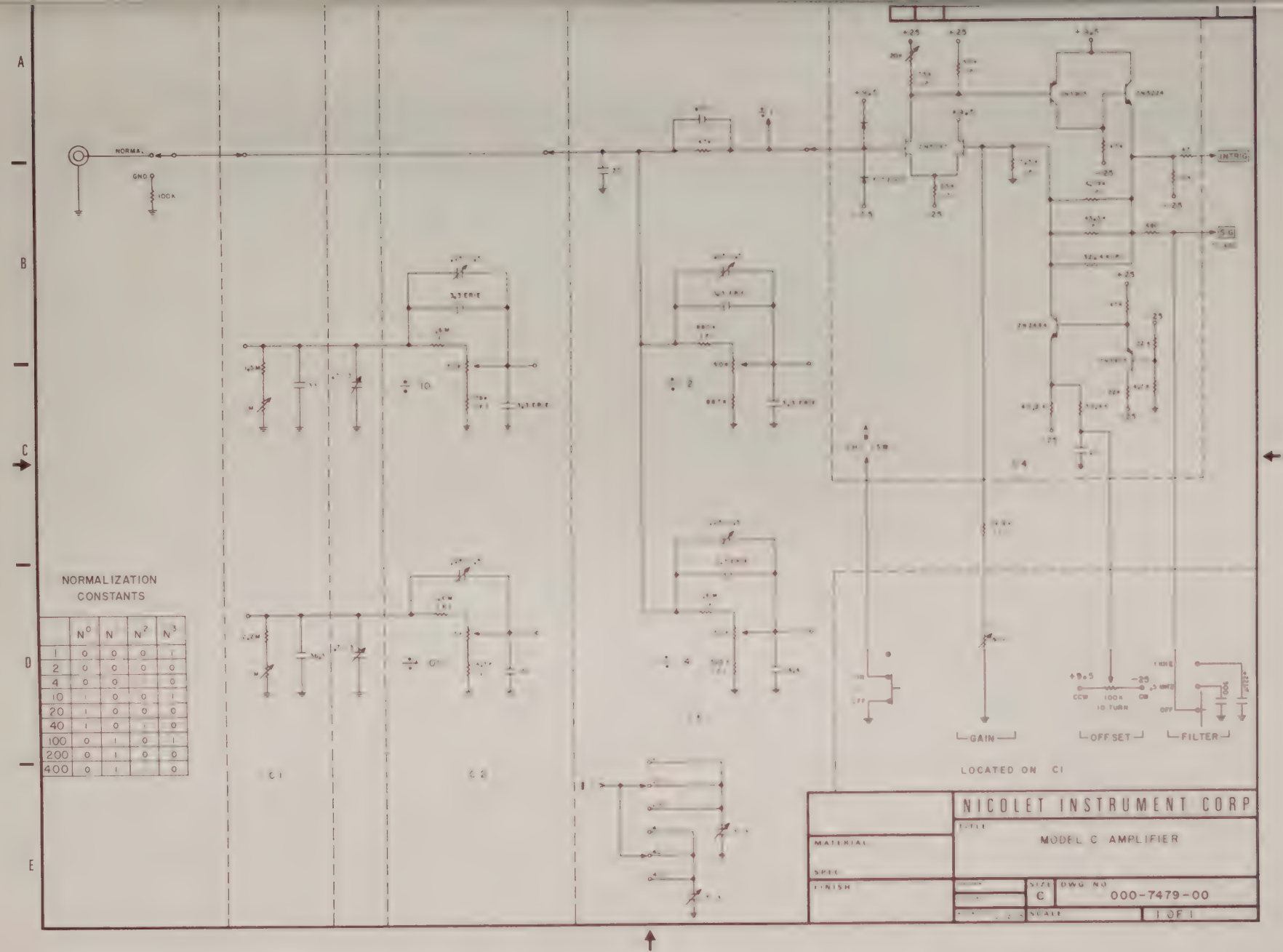


MATERIAL	NICOLET INSTRUMENT CORP
SPEC	TITLE: CONNECTOR & BOARD PLACEMENT DIAGRAM MODEL 1090 AR
FINISH	SIZE C · DWG NO
	SCALE



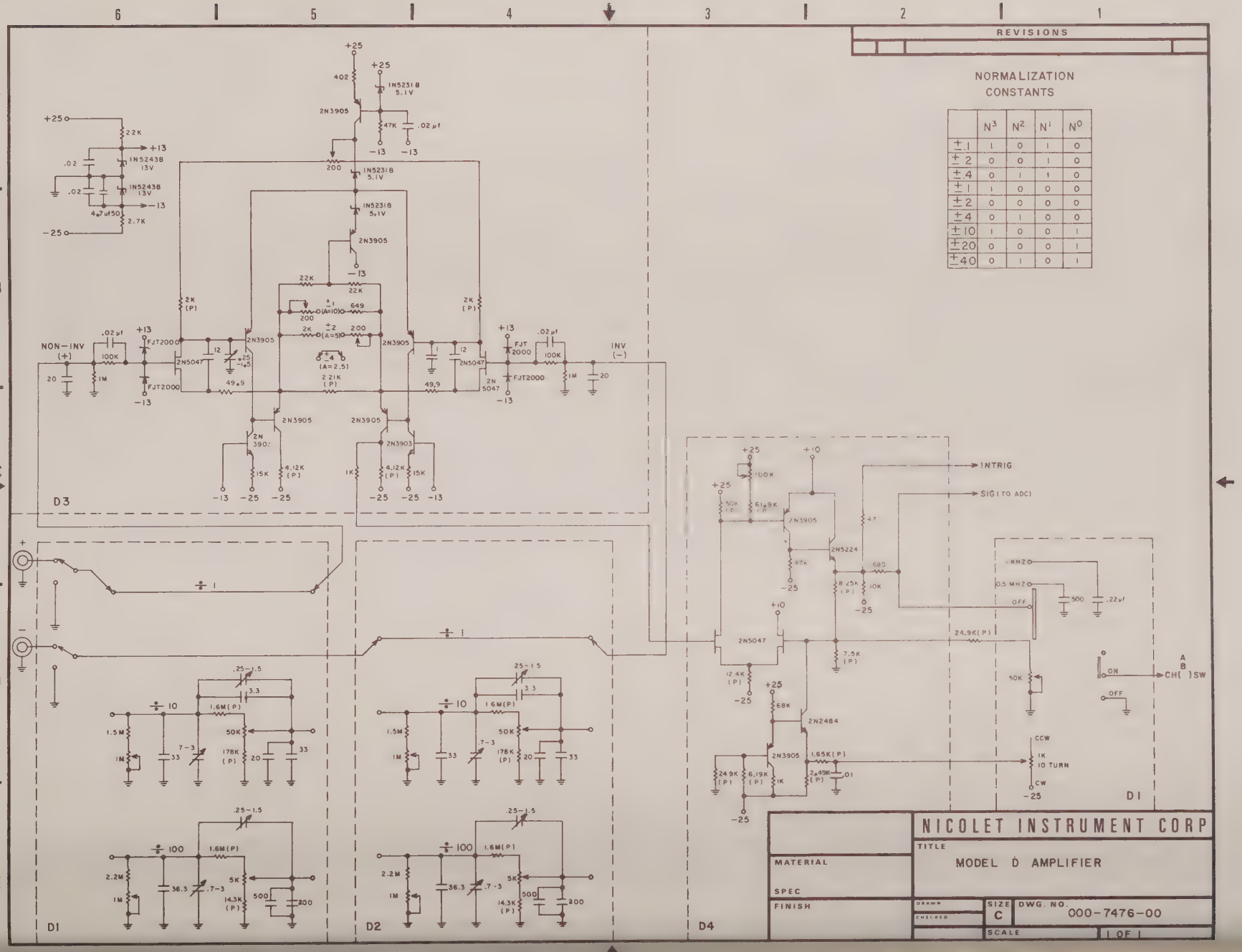
MODEL 94A PLUG-IN

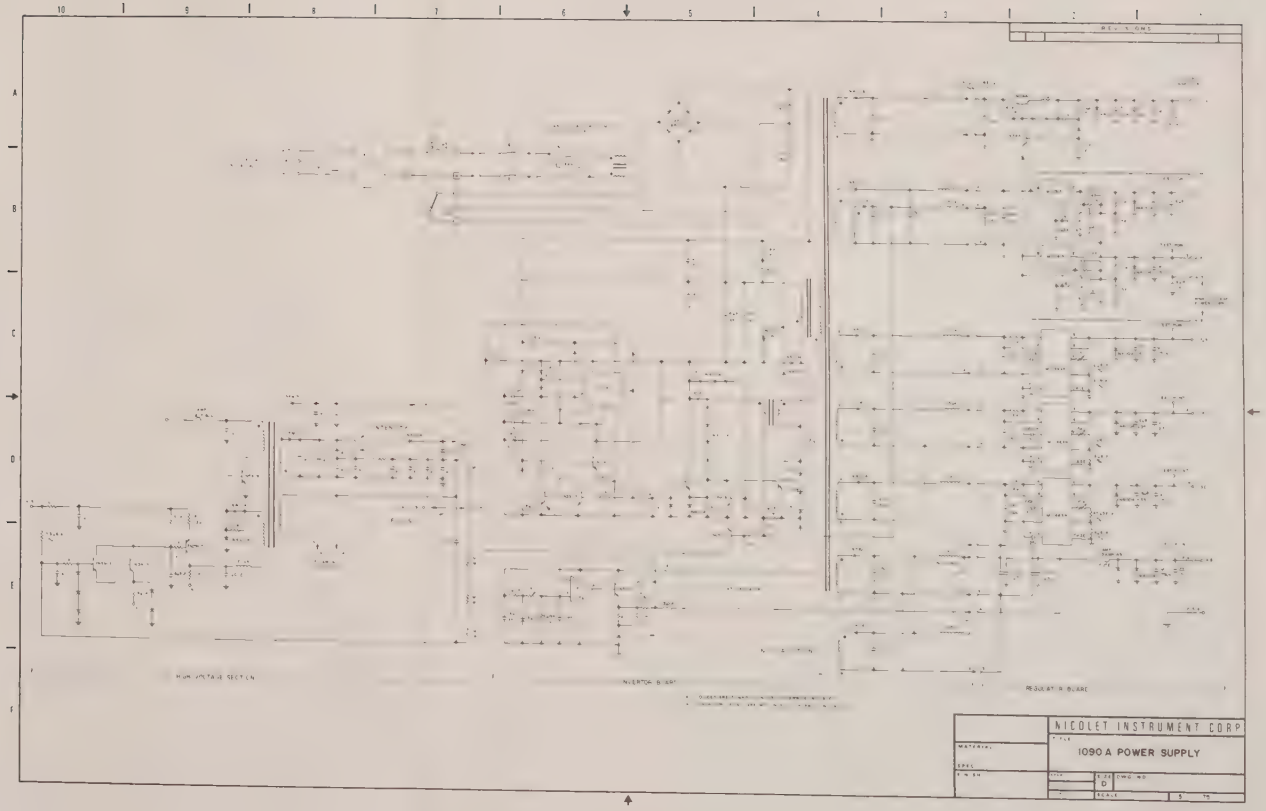
MATERIAL	DRAWN	NICOLET INSTRUMENT CORP
SPEC.	CHECKED	TITLE: BOARD PLACEMENT DIAGRAM
FINISH	APPROVED	SCALE / DWG. NO.

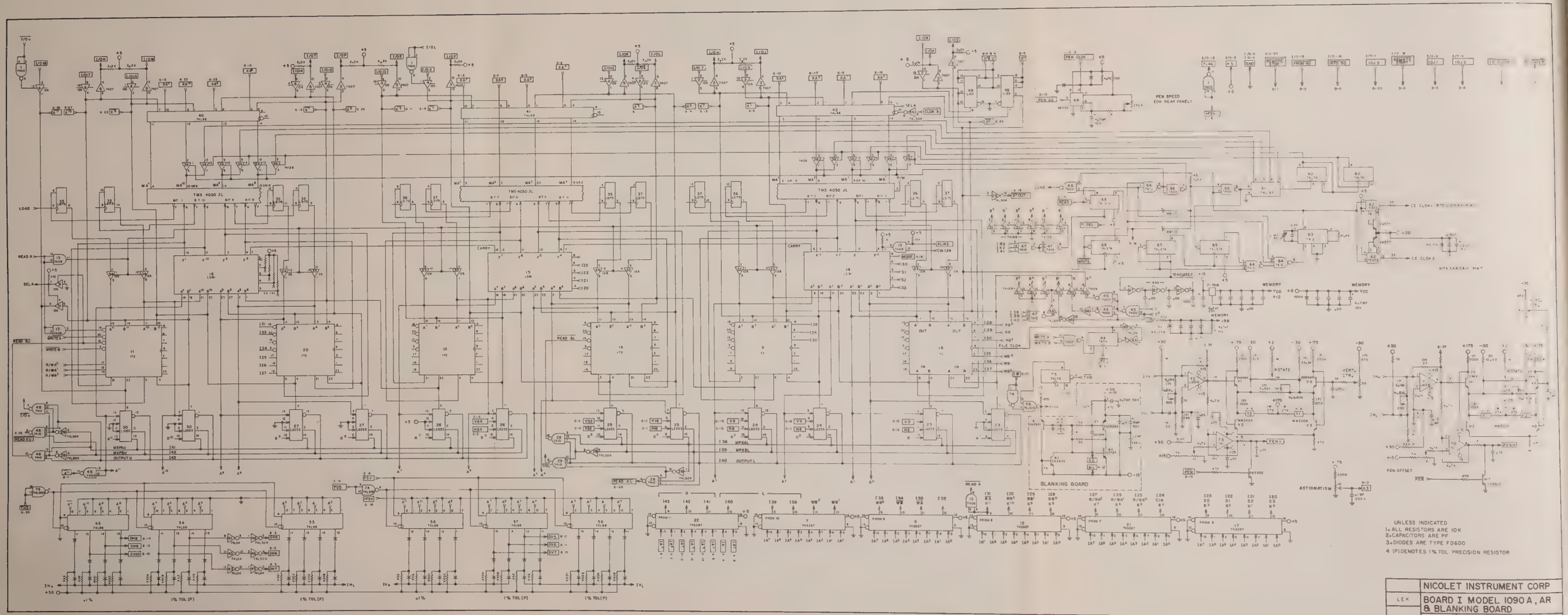


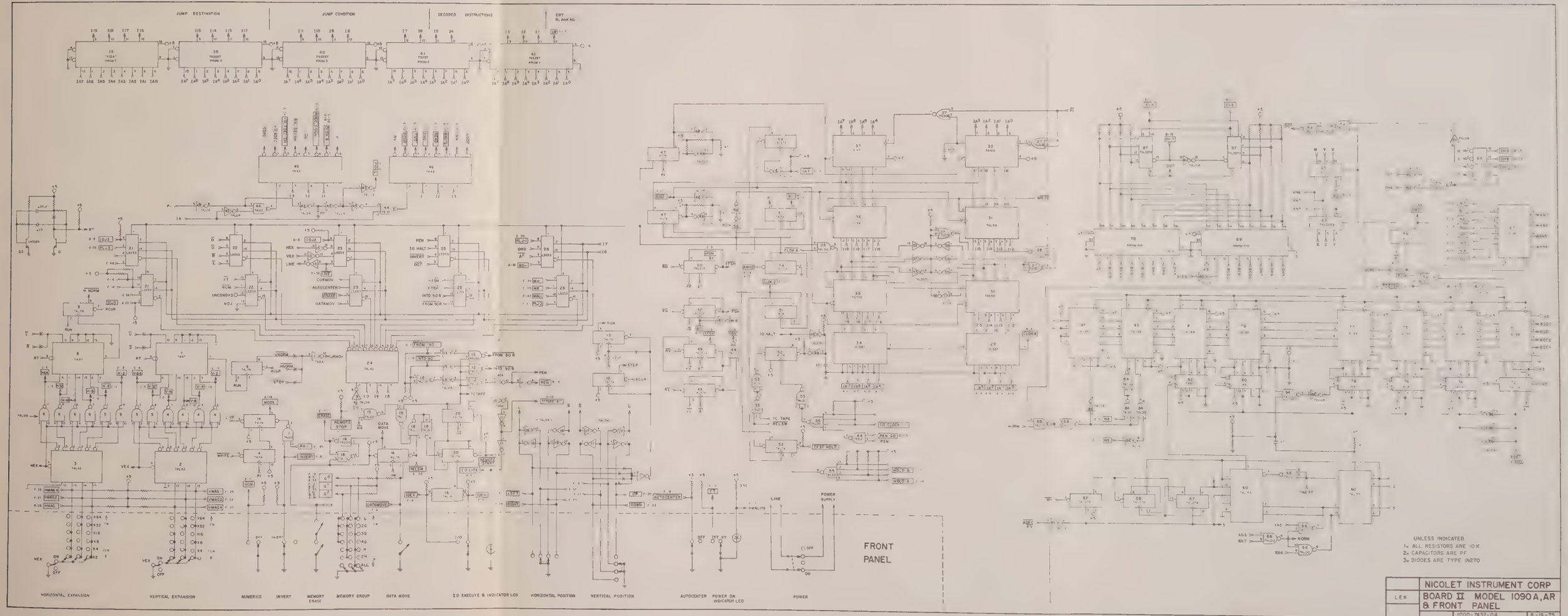
NORMALIZATION CONSTANTS

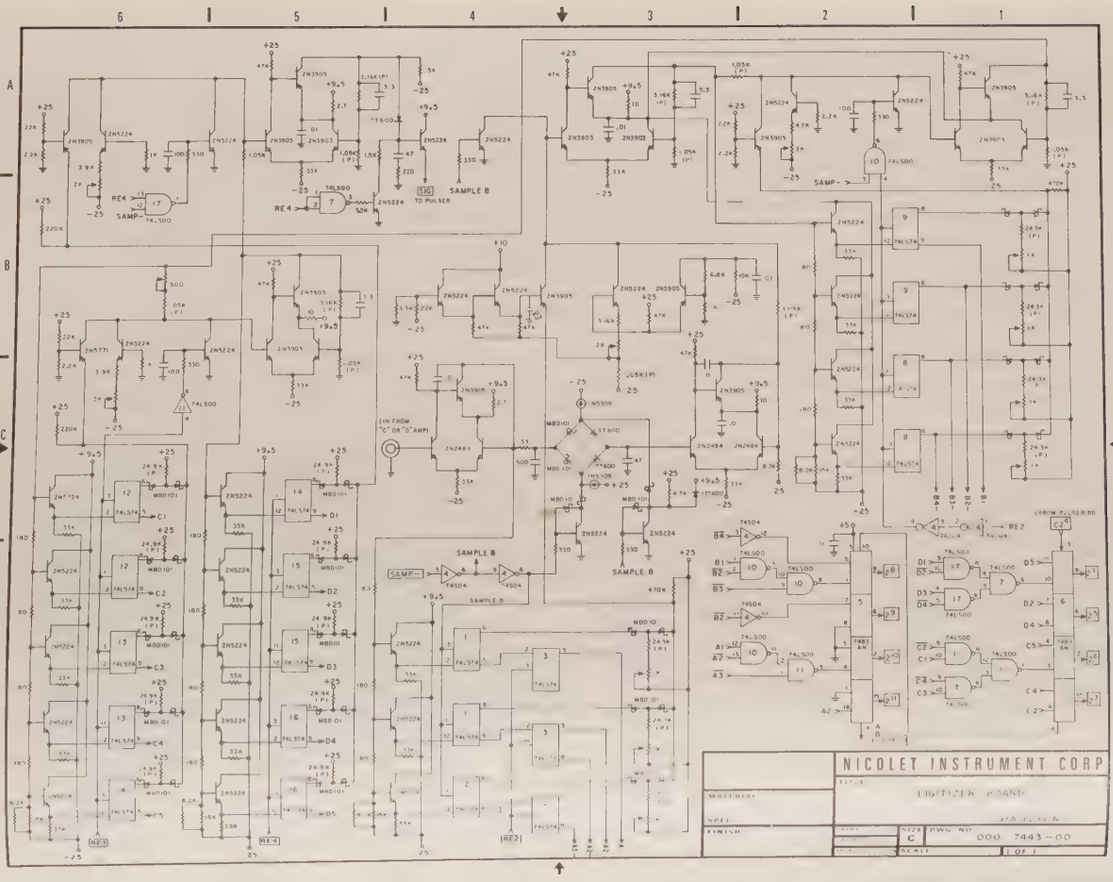
	N^0	N^1	N^2	N^3
1	0	0	0	1
2	0	0	0	0
4	0	0		0
10	1	0	0	1
20	1	0	0	0
40	1	0	1	0
100	0	1	0	1
200	0	1	0	0
400	0	1	1	0

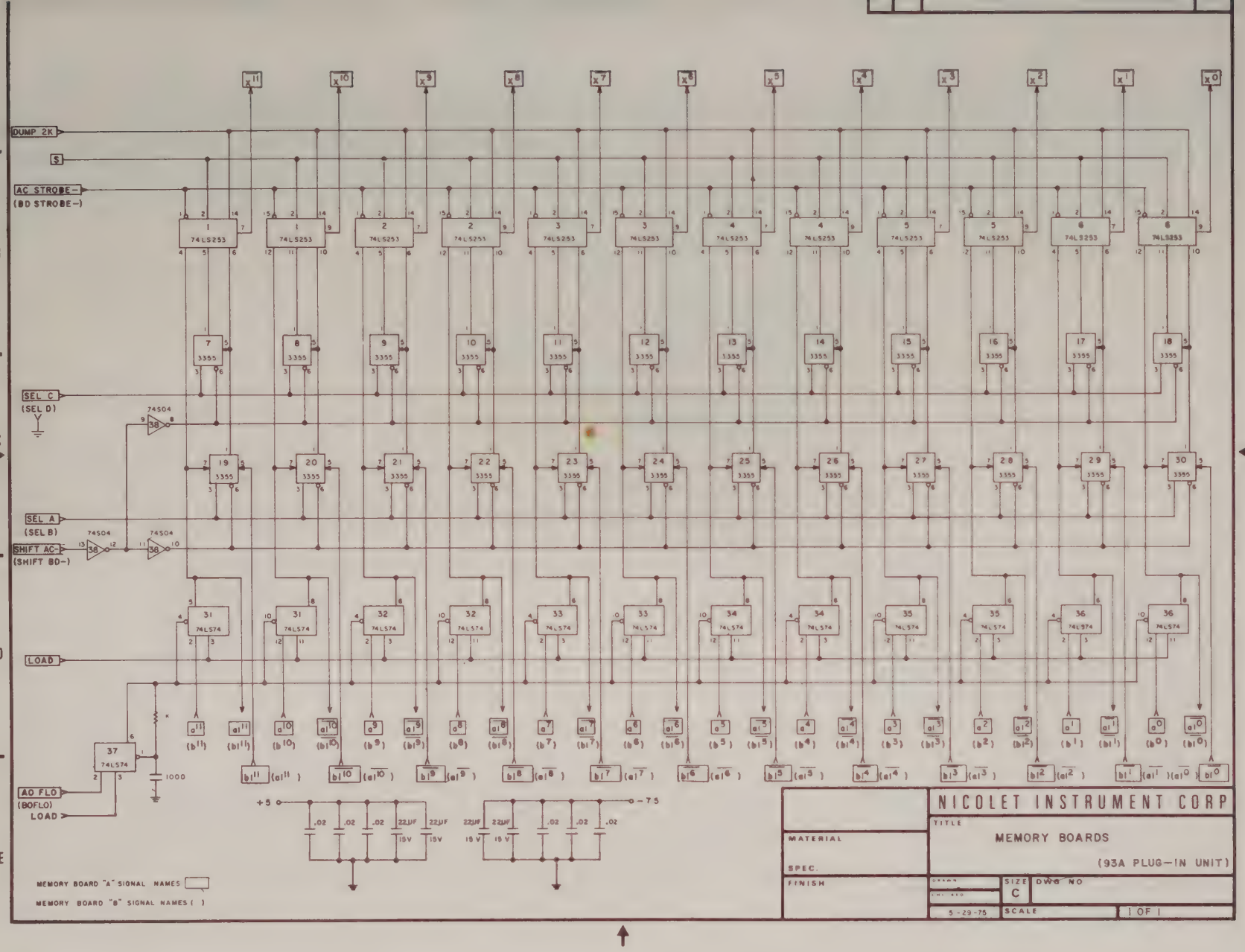

REVISIONS
NORMALIZATION CONSTANTS
N3 N2 N1 N0
±1 1 0 1 0
±2 0 0 1 0
±4 0 1 1 0
±1 1 0 0 0
±2 0 0 0 0
±4 0 1 0 0
±10 1 0 0 1
±20 0 0 0 1
±40 0 1 0 1
NON-INV (+)
INV (-)
D3
D1
D2
D4
INTRIG
SIG (TO ADC)
CH( )SW
NICOLET INSTRUMENT CORP
TITLE
MODEL D AMPLIFIER
MATERIAL
SPEC
FINISH
DRAWN
CHECKED
SIZE C
DWG. NO. 000-7476-00
SCALE
1 OF 1

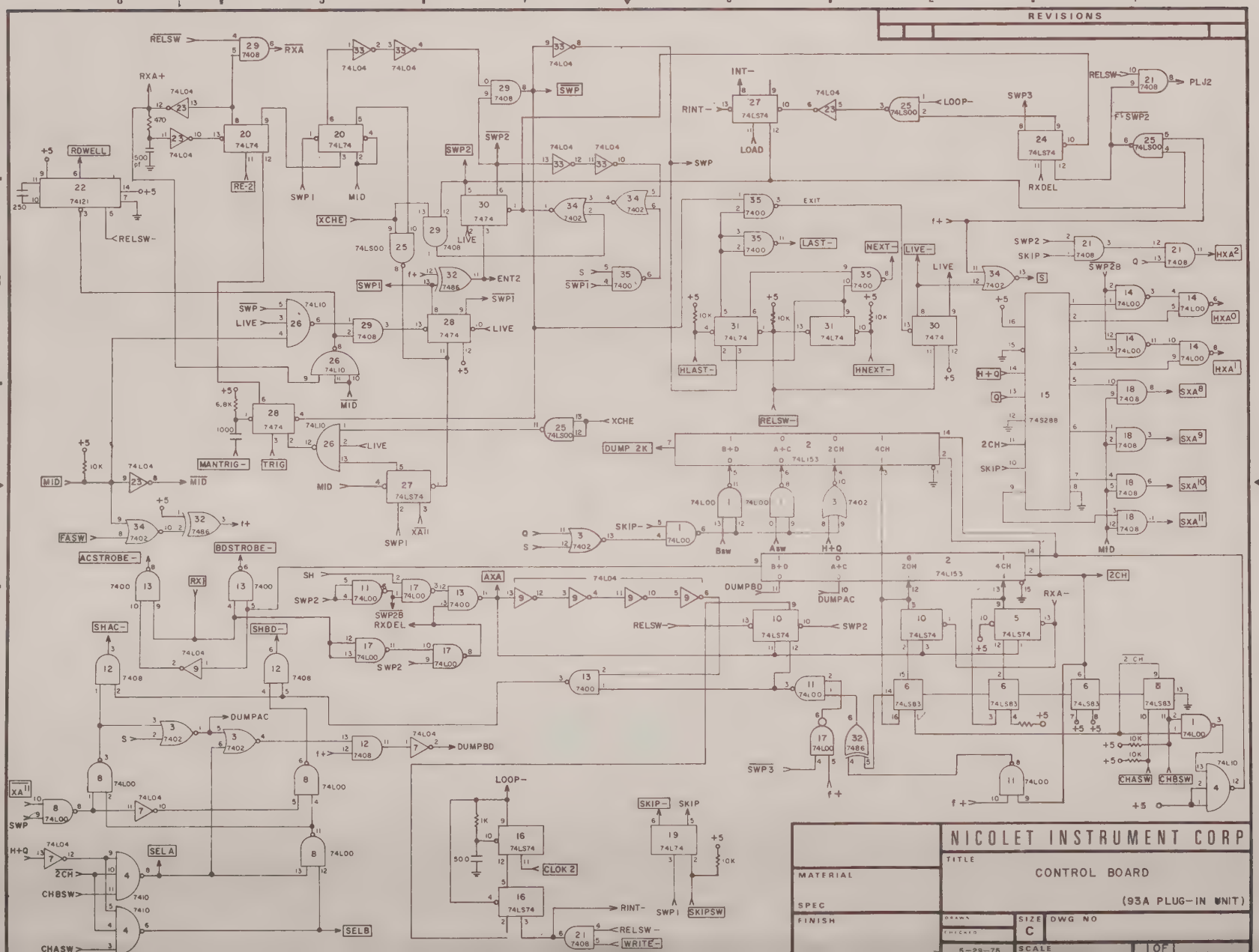

NICOLET INSTRUMENT CORP
1090 A POWER SUPPLY

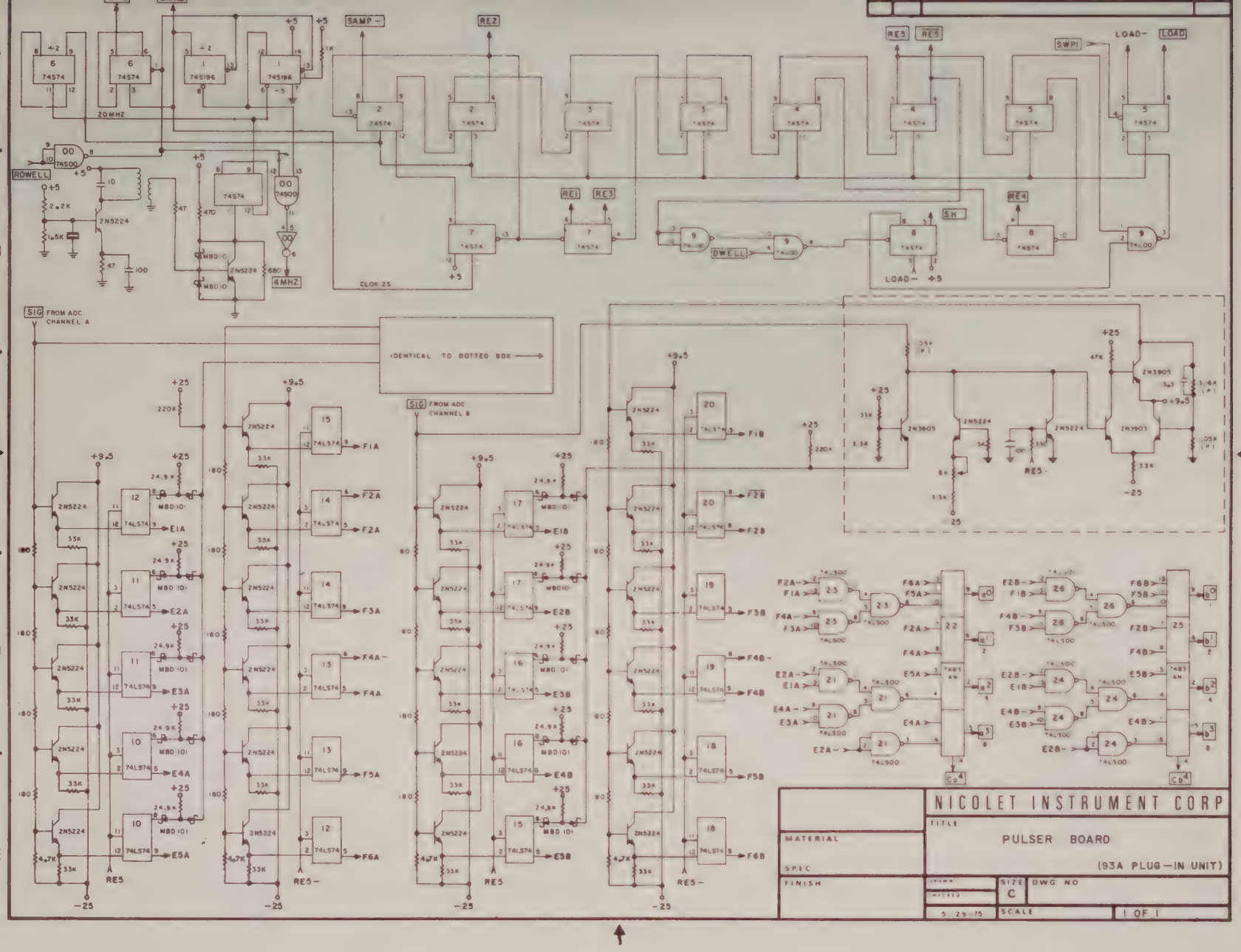

TMS 4030 JL
BLANKING BOARD
PEN SPEED
(ON REAR PANEL)
MEMORY
ROTATE
ASTIGMATISM
PEN OFFSET
UNLESS INDICATED
1= ALL RESISTORS ARE 10K
2=CAPACITORS ARE PF
3=DIODES ARE TYPE FD600
4 (P)DENOTES 1% TOL PRECISION RESISTOR
NICOLET INSTRUMENT CORP
LEK
BOARD I MODEL 1090A, AR
& BLANKING BOARD
1000-7449-02
8-27-75


JUMP DESTINATION
JUMP CONDITION
DECODED INSTRUCTIONS
CRT BLANKING
FRONT PANEL
HORIZONTAL EXPANSION
VERTICAL EXPANSION
NUMERICS
INVERT
MEMORY ERASE
MEMORY GROUP
DATA MOVE
IO EXECUTE & INDICATOR LED
HORIZONTAL POSITION
VERTICAL POSITION
AUTOCENTER
POWER ON INDICATOR LED
POWER
UNLESS INDICATED
1. ALL RESISTORS ARE 10K
2. CAPACITORS ARE PF
3. DIODES ARE TYPE IN270
NICOLET INSTRUMENT CORP
LEK
BOARD II MODEL 1090A,AR & FRONT PANEL
1000-7432-04
8-19-75


NICOLET INSTRUMENT CORP
DIGITIZER BOARD
SIZE C
DWG NO 000 7443-00
SCALE
SHEET 1 OF 1
SAMPLE B
TO PULSER
SAMP
RE1
RE2
RE3
RE4


DUMP 2K
S
AC STROBE-
(BD STROBE-)
SEL C
(SEL D)
SEL A
(SEL B)
SHIFT AC-
(SHIFT BD-)
LOAD
AO FLO
(BOFLO)
LOAD
74LS253
3355
74LS574
74S04
1000
+5
-7.5
.02
22µF
15V
MEMORY BOARD "A" SIGNAL NAMES
MEMORY BOARD "B" SIGNAL NAMES ( )
NICOLET INSTRUMENT CORP
TITLE
MEMORY BOARDS
(93A PLUG-IN UNIT)
MATERIAL
SPEC.
FINISH
SIZE
C
DWG NO
5-29-75
SCALE
1 OF 1


REVISIONS
NICOLET INSTRUMENT CORP
TITLE
CONTROL BOARD
(93A PLUG-IN UNIT)
MATERIAL
SPEC
FINISH
SIZE
C
DWG NO
SCALE
1 OF 1
5-29-75
RELSW
RXA
RXA+
RDWELL
RE-2
SWP1
MID
SWP2
SWP
XCHE
LIVE
ENT2
INT-
RINT-
LOAD
LOOP-
SWP3
RXDEL
PLJ2
EXIT
LAST-
NEXT-
HLAST-
HNEXT-
HXA2
HXA0
HXA1
SXA8
SXA9
SXA10
SXA11
MANTRIG-
TRIG
DUMP 2K
XA11
FASW
ACSTROBE-
BDSTROBE-
SHAC-
SHBD-
SWP2B
DUMPAC
DUMPBD
SELA
SELB
CHASW
CHBSW
CLOK 2
SKIP-
SKIPSW
WRITE-
RELSW-
2CH
4CH
SKIP
LOOP-
-68-



NICOLET INSTRUMENT CORP

TITLE: PULSER BOARD (93A PLUG-IN UNIT)

MATERIAL

SPEC

FINISH

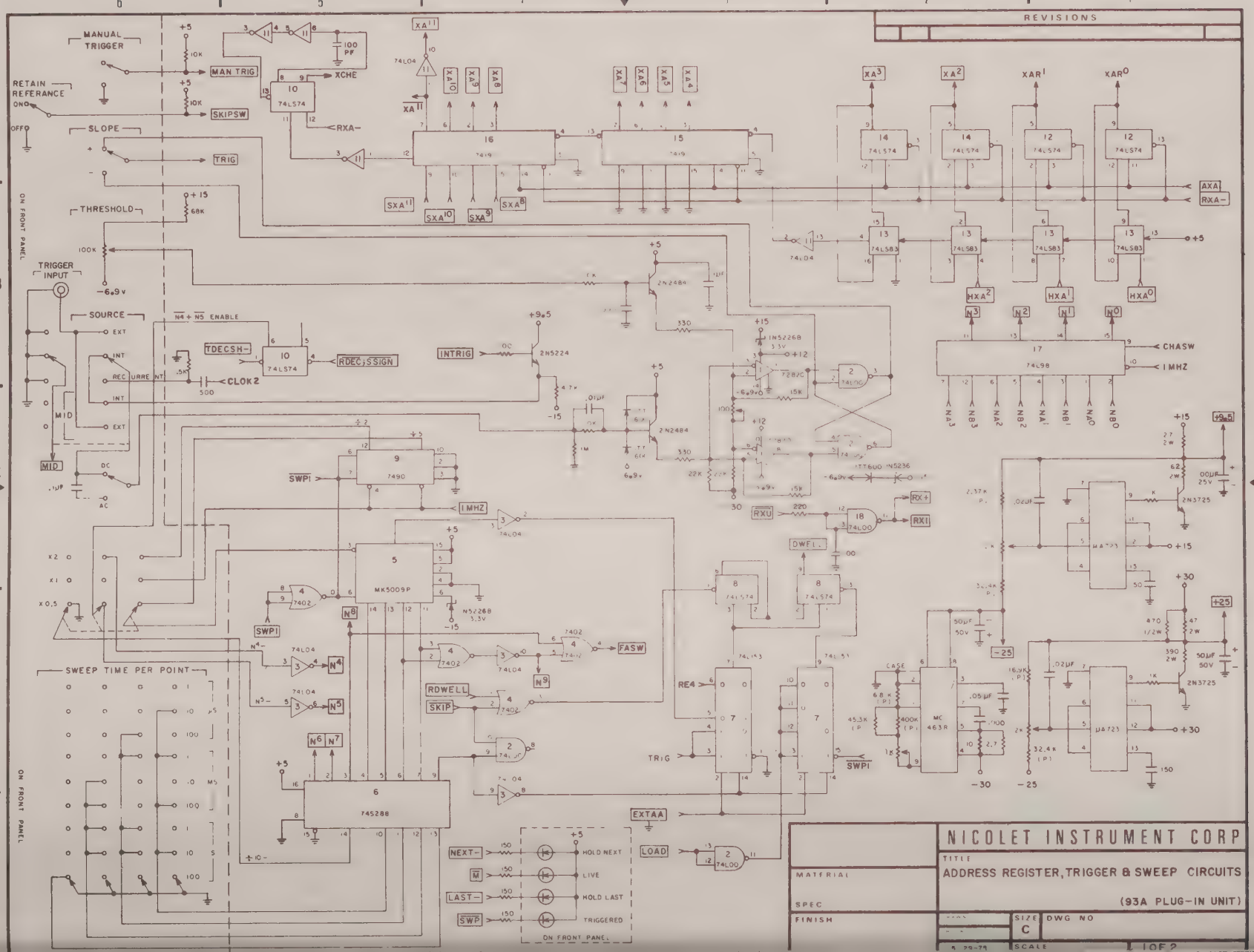
SIZE C

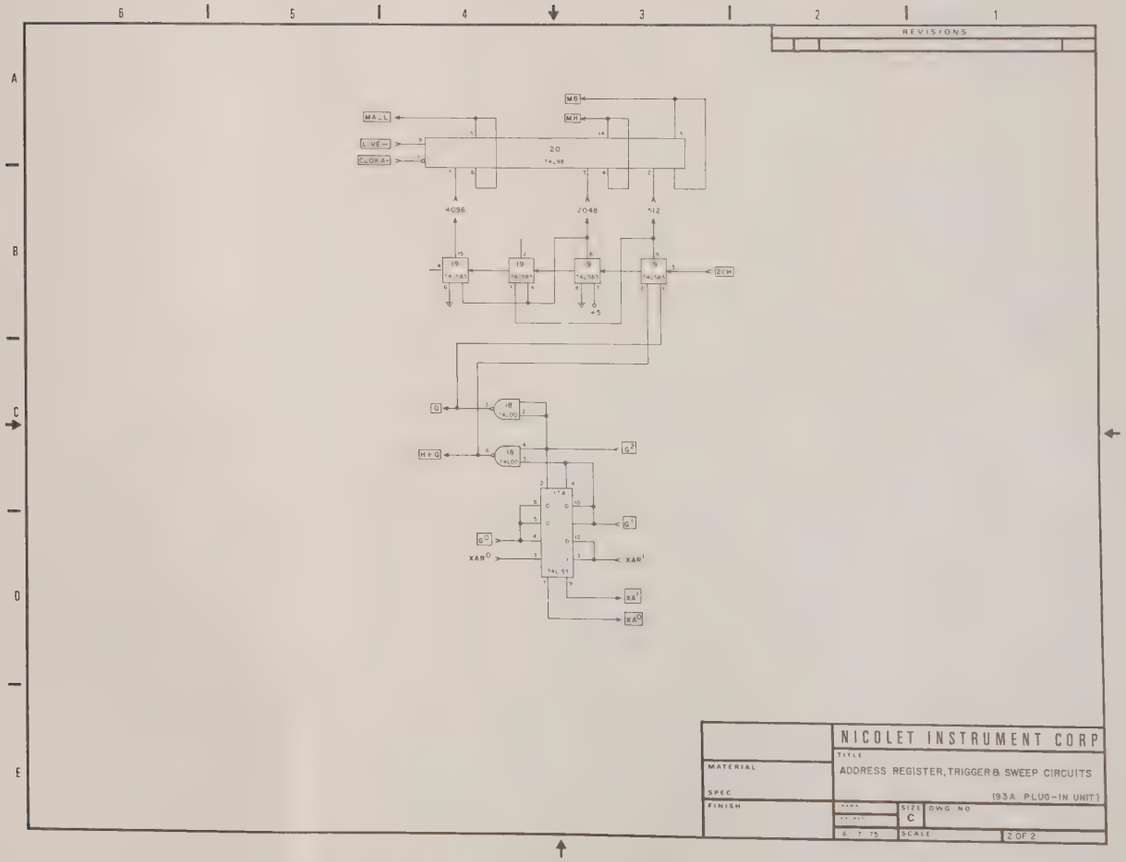
DWG NO

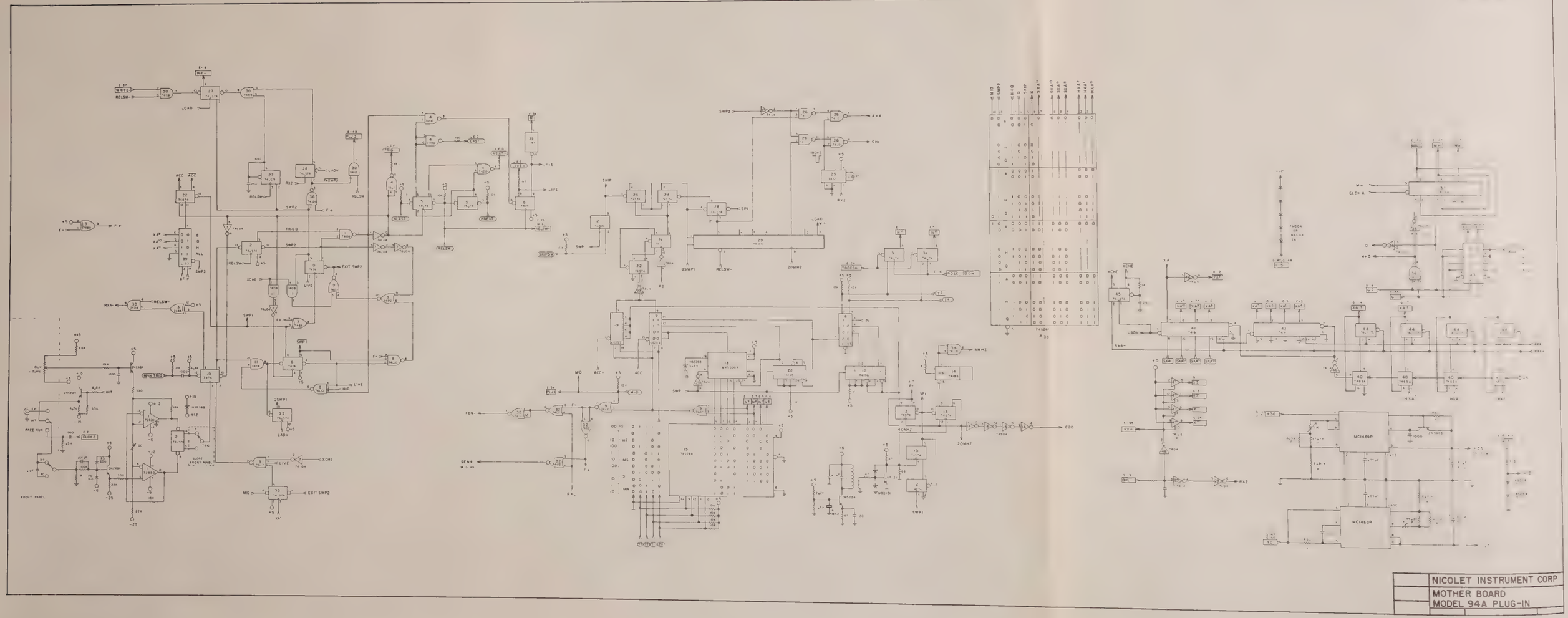
5-29-75

SCALE

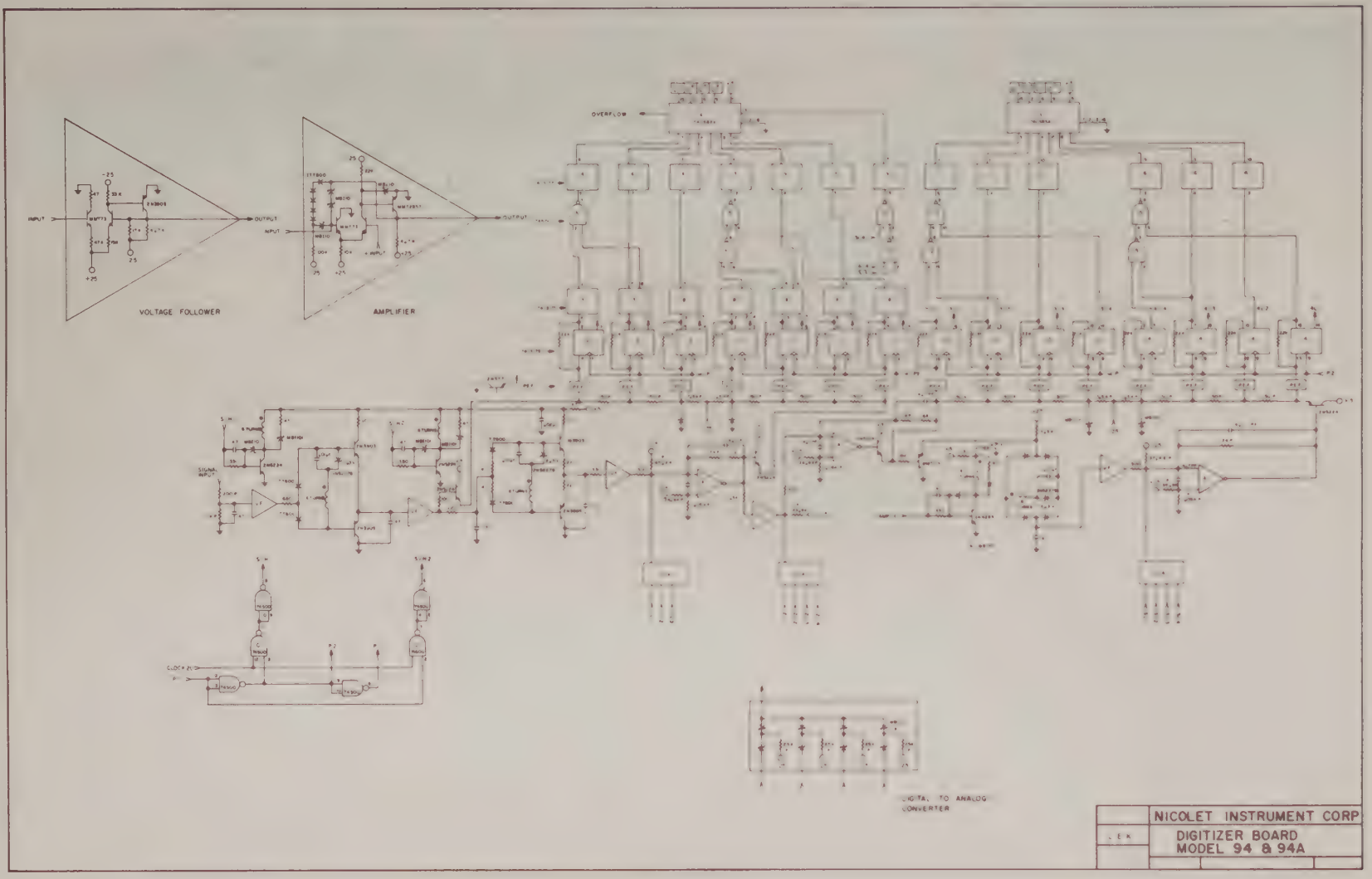
1 OF 1

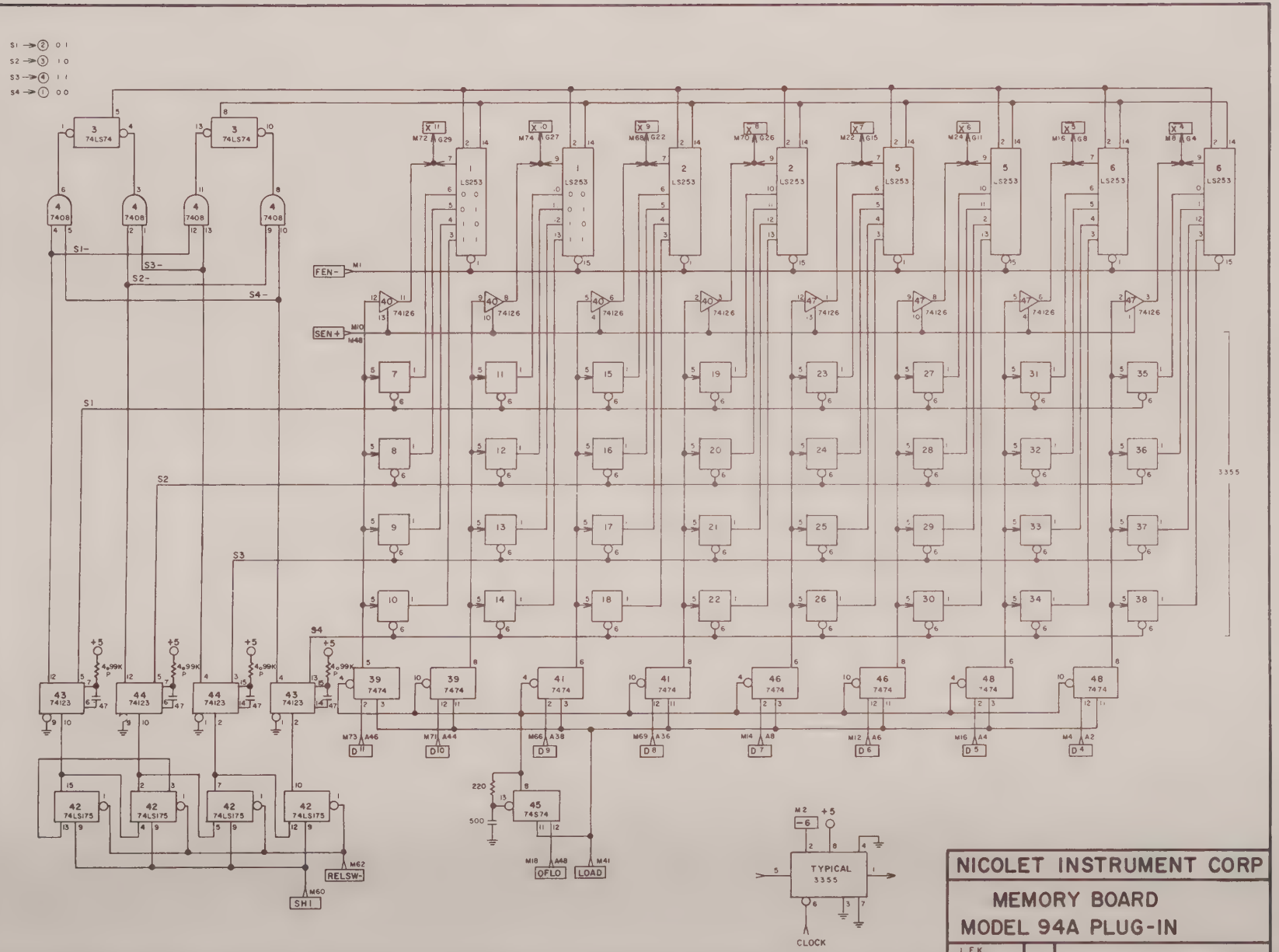

REVISIONS
NICOLET INSTRUMENT CORP
TITLE
ADDRESS REGISTER, TRIGGER & SWEEP CIRCUITS
(93A PLUG-IN UNIT)
MATERIAL
SPEC
FINISH
SIZE C
DWG NO
SCALE
1 OF 2
MANUAL TRIGGER
RETAIN REFERANCE
SLOPE
THRESHOLD
TRIGGER INPUT
SOURCE
SWEEP TIME PER POINT
MAN TRIG
SKIPSW
TRIG
XCHE
RXA-
TDECSH-
RDECJSSIGN
CLOK2
INTRIG
SWPI
IMHZ
FASW
RDWELL
SKIP
RXU
RX+
RX1
DWFL
EXTAA
LOAD
CHASW
NEXT-
LAST-
SWP
HOLD NEXT
LIVE
HOLD LAST
TRIGGERED
ON FRONT PANEL


REVISIONS
MA_L
L_VE
CLOCK A
ME
MX
20
4096
2048
512
2CH
+5
Q
H+Q
G²
G¹
G⁰
XAR⁰
XAR¹
XA¹
XA⁰
NICOLET INSTRUMENT CORP
MATERIAL
SPEC
FINISH
TITLE
ADDRESS REGISTER, TRIGGER & SWEEP CIRCUITS
(93A PLUG-IN UNIT)
SIZE
C
DWG NO
SCALE
2 OF 2



	NICOLET INSTRUMENT CORP
	MOTHER BOARD
	MODEL 94A PLUG-IN


VOLTAGE FOLLOWER
AMPLIFIER
OVERFLOW
SIGNAL INPUT
CLOCK
DIGITAL TO ANALOG CONVERTER
NICOLET INSTRUMENT CORP
DIGITIZER BOARD
MODEL 94 & 94A



NICOLET INSTRUMENT CORP

MEMORY BOARD
MODEL 94A PLUG-IN

LEK | C

PARTS LIST:

	Page
Subassembly, 1090A	77
Subassembly, 1090AR	78
Converter to Regulator Cable	79
Power Supply Board/Regulator (4 sheets)	80
Board I (Horizontal) (5 sheets)	84
Board II (Vertical) (3 sheets)	89
Converter Board (3 sheets)	92
Main Frame, 1090A (2 sheets)	95
Front Panel, 1090A (2 sheets)	97
Lower Rear Panel, 1090A (2 sheets)	99
Upper Rear Panel, 1090A	101
Belt Connector Kit, 1090A	102
Blanking Board, 1090A	103
Blanking Board, 1090A/AR	104
Main Frame, 1090AR (2 sheets)	105
Front Panel, 1090AR (2 sheets)	107
Rear Panel, 1090AR (2 sheets)	109
Subassembly, 93A	111
Final Assembly, 93A	112
Front Panel, 93A (2 sheets)	113
Pulser Board, 93A (2 sheets)	115
Control Board, 93A (2 sheets)	117

PARTS LIST (continued)

Address, Trigger and Sweep, 93A (3 sheets) 119

Digitizer Board, 93A (3 sheets) 122

Memory Board, 93A 125

Subassembly, 94A 126

Final Assembly, 94A 127

Front Panel, 94A 128

Mother Board, 94A (5 sheets) 129

ADC Board, 94A (4 sheets) 134

Memory Board, 94A 138

Subassembly, C Amplifier 139

Final Assembly, C Amplifier (2 sheets) 140

Board 1, C Amplifier 142

Board 2, C Amplifier 143

Board 3, C Amplifier 144

Board 4, C Amplifier (2 sheets) 145

Subassembly, D Amplifier 147

Final Assembly, D Amplifier (2 sheets) 148

Combination Board 1, D Amplifier (2 sheets) 150

Combination Board 2, D Amplifier (2 sheets) 152

Board 3, D Amplifier (2 sheets) 154

Board 4, D Amplifier (2 sheets) 156

PARTS LIST

INSTRUMENT TITLE Sub-Assembly MODEL 1090A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1			Main Frame Assembly			
1			Front Panel Assembly			
1			Board I Assembly			
1			Board II Assembly			
1			Blanking Board Assembly			
1			Convertor Board/Mini Power Supply I			
1			Reg. Board/Mini Power Supply I			
1			Lower Rear Panel/Mini Power Supply I			
1			Upper Rear Panel/Mini Power Supply I			
1			Convertor to regulator cable/Mini Power Supply I			

PARTS LIST

INSTRUMENT TITLE Sub-Assembly MODEL 1090AR

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1			Main Frame Assembly			
1			Front Panel Assembly			
1			Rear Panel Assembly			
1			Board I Assembly			
1			Board II Assembly			
1			Blanking Board Assembly			
1			Power Supply Regulator Board Assembly			
1			Power Supply Convertor Board Assembly			
1			Convertor To Regulator Cable Assembly			

INSTRUMENT TITLE 1090A/1090AR/1090 NSC MODEL Converter to Regulator Cable

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
2		1024-7199-00	Socket Housing	15 Pin	Amp	1-350244-9
30	fs	1015-7028-00	Socket Pins		Amp	350037-2

PARTS LIST

INSTRUMENT TITLE 1090A/1090AR MODEL Power Supply Board/Reg.

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7472-01	P. C. Board			
2		1134-7057-00	OP. Amp.		T.I.	SN72741P
2		1023-7139-00	Capacitor	.001 mfd @ 2KV	Sprague	BL-D10
3		1023-7118-00	Capacitor	.001 mfd @ 200 V	Sprague	192P10292
10		1023-7015-00	Capacitor	.01 mfd @ 2	Sprague	BL-S10
3		1023-7070-00	Capacitor	.02 mfd @ 100 V	Sprague	5HK-S20
11		1023-7113-00	Capacitor	.1 mfd @ 250 V	Seacor	
1		1023-7073-00	Capacitor	1 mfd @ 200 V	TRW	X663FR
6		1023-7075-00	Capacitor	6.8 mfd @ 35 V	Kemet	
1		1023-7110-00	Capacitor	22 mfd @ 35 V	Kemet	T310C225-K-03AS
2		1023-7035-00	Capacitor	100 mfd @ 25 V	Sprague	TE-1211
2		1023-7140-00	Capacitor	100 mfd @ 50 V	Sprague	39D107G050EJ4
2		1023-7112-00	Capacitor	220 mfd @ 10 V	T.I.	SCM227HP010D2
2		1023-7138-00	Capacitor	2000 mfd @ 7.5 V	Corn-Dub	UFT-2000-7.5
3		1022-7092-00	Regulator	MC1463R	Motorola	
2		1022-7090-00	Regulator	MC7815CP	Fairchild or Motorola	
11		1022-7008-00	Diode		ITT	1N4004

INSTRUMENT TITLE 1090A/1090AR MODEL Power Supply Board/Reg.

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
9	fs	1022-7084-00	Diode		ITT	1N5063
1		1022-7051-00	Diode		Motorola	1N5268
2		1022-7069-00	Diode		Semtech	SEM 50
1		1021-7051-00	Transistor		T.I.	2N2905A
2		1021-7035-00	Transistor		RCA	2N3440
2		1021-7022-00	Transistor		Semicon. Spec.	2N3205
1		1021-7038-00	Transistor		Motorola	2N5678
1		1098-7002-00	Heat Sink		Wakefield	NE 207
2		1026-7057-00	Trim Pot	5K	Helipot	
1		1026-7058-00	Trim Pot	10K	Helipot	
2		1026-7065-00	Potentiometer	500K	Bourns	3852Z-A31-504A
1		1019-7043-00	Choke		Nytronics	R-1550-0129
1		1019-7044-01	H.V. Coil			
1		1067-7003-00	E. Core		Allen-Bradley	E1960-S-011A
1		1067-7004-00	E. Core		Allen-Bradley	E1960-S-021A
4		1214-0253-00	1% Prec. Resistor	35K ± 1%	Kidco	
2		1201-0010-00	1% Prec. Resistor	1 ohm ± 1%	IRC	AS-1

INSTRUMENT TITLE 1090A/1090AR MODEL Power Supply Board/Reg.

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1201-5362-00	Prec. Resistor	53.6K	IRC	
4		1201-6810-00	Prec. Resistor	6.81K @ 1%	IRC	
2		1201-2002-00	Prec. Resistor	20K	IRC	
1		1201-4532-00	Prec. Resistor	45.3K @ 1%	IRC	
1		1201-1963-00	Prec. Resistor	196K @ 1%	IRC	
1		1101-0390-00	Resistor	3.9 ohm @ 1/2W	Allen-Bradley	
1		1101-0102-00	Resistor	1K 1/2W	Allen-Bradley	
1		1101-0473-00	Resistor	47K 1/2W	Allen-Bradley	
4		1103-0105-00	Resistor	1 Meg. 1W	Allen-Bradley	
1		1070-7016-00	Fuse	7 Amp/125V/3AG	Littlefuse	
1		1070-7008-00	Fuse	1 Amp/250V/3AG	Littlefuse	312001
4		1070-7010-00	Fuse Clips		Littlefuse	102068
2		1024-7196-00	Pin Header	15 Circuit	Amp	9-350368-1
1		1024-7195-00	Pin Header	9 Circuit	Amp	9-350262-1
3		1098-7008-00	Heat Sink			6168B
2			Terminal Lug	.375 Hole	Zierick	558
2		1023-7002-00	Capacitor	1000 pfd @ 100 V		

INSTRUMENT TITLE 1090A/1090AR MODEL Power Supply Board/Reg.

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1023-7121-00	Capacitor	.01 @ 200 V		
4		1201-6810-00	Prec. Resistor	6.81K		

PARTS LIST

INSTRUMENT TITLE Board I (Horizontal) MODEL 1090 A/AR

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7449-04	P. C. Board			
6		1134-7174-00	I. C.		T. I.	SN74S287N
1	B	1134-7224-00	I. C.		T. I.	SN74LS139
3		1134-7131-00	I. C.		T. I.	SN74LS181N
6		1134-7126-00	I. C.		T. I.	SN74172N
13	B	1134-7225-00	I. C.		T. I.	SN74LS126
1		1134-7129-00	I. C.		T. I.	SN74LS04N
6		1134-7137-00	I. C.		T. I.	SN74LS253N
9	B	1134-7226-00	I. C.		T. I.	SN74LS298
1		1134-7095-00	I. C.		T. I.	SN7410N
1		1134-7060-00	I. C.		T. I.	SN7474N
3		1134-7132-00	I. C.		T. I.	SN74LS74N
2		1134-7128-00	I. C.		T. I.	SN74LS00N
1		1134-7079-00	I. C.		T. I.	SN74121N
5		1134-7092-00	I. C.		T. I.	SN74L98N
1		1134-7044-00	I. C.		National	836
1	B	1134-7227-00	I. C.		T. I.	SN74LS0B
1		1134-7129-00	I. C.		T. I.	SN74LS04

INSTRUMENT TITLE Board I (Horizontal) MODEL 1090 A/AR

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
2		1134-7018-00	I. C.		T. I.	SN7400N
12		1134-7213-00 1134-7214-00	I. C. I. C.		T. I. Intel	4060JL (Either of these RAMS can be used C-2107B-4 But don't mix them)
2		1134-7197-00	I. C.		T. I.	SN7407N
2		1134-7081-00	I. C.		T. I.	SN74L74N
1		1134-7155-00	I. C.		T. I.	SN74LS153
1		1134-7094-00	I. C.		T. I.	SN74L193N
1	B	1134-7196-00	I. C.		T. I.	SN75322
3		1134-7188-00	I. C.		T. I.	SN74LS175N
2		1134-7215-00	I. C.		Analog Devices	AD563JDBIN
2		1134-7057-00	I. C. (Op. Amp.)	(Plastic cap)	T. I.	72741
1		1134-7115-00	I. C. (Timer)		Signetics	NE555
7		1023-7111-00	Capacitor	4.7 @ 10V		
1		1023-0292-00	Capacitor	22 @ 15V		
1		1023-7016-00	Capacitor	2.2 @ 20V		
33		1023-7151-00	Capacitor	.05 @ 50V	Arco	
1		1023-7113-00	Capacitor	.1 @ 250V		
1		1023-7179-00	Capacitor	8 pf 300V		
1		1023-7178-00	Capacitor		Arco	DM5CC060A

INSTRUMENT TITLE Board I (Horizontal) MODEL 1090A/AR

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1022-7008-00	Diode		ITT	IN4004
2		1022-7011-00	Diode		Sylvania	IN270
2	fs	1022-7184-00	Diode		ITT	600
3		1022-7028-00	Diode		Motorola	IN5230
2		1021-7042-00	Transistor		Fairchild	2N5771
2		1021-7025-00	Transistor		ITT	2N3302
4		1021-7006-00	Transistor		T. I.	2N2484
4		1021-7048-00	Transistor		Motorola	MM3009
2		1134-7119-00	Amplifier		National or AMD	LM318H
1		1022-7101-00	Voltage Regulator	7812 UC	Fairchild	
2		1026-7055-00	Trimpot	1K		89PR
2		1026-7053-00	Trimpot	200 Ohm		Helitrim (89)
5		1026-7057-00	Trimpot	5K		Helitrim (89)
3		1026-7064-00	Trimpot	1 Meg		Helitrim (89)
1	B	1026-7078-00	Pot (Pen Adjust)	1 Turn 250K	Centralab	BA811-6670
2		1201-1003-00	Prec. Resistor	100K 1%		
2		1201-2002-00	Prec. Resistor	20K 1%		
1		1201-1652-00	Prec. Resistor	16.5K 1%		

INSTRUMENT TITLE Board I (Horizontal) MODEL 1090A/AR

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1201-2491-00	Prec. Resistor	2.49K 1%		
1		1201-2432-00	Prec. Resistor	24.3K 1%		
1		1214-4990-00	Prec. Resistor	499 Ohm		
4		1201-2003-00	Prec. Resistor	200K 1%		
8		1024-7159-00	Socket	16 Pin		
12		1024-7223-00	I. C. Socket	22 Pin		
1		1024-7216-00	Socket Housing	4 Pin (F)	AMP	1-350240-9
1		1024-7217-00	Pin Housing	4 Pin (M)	AMP	1-350253-0
1		1024-7147-00	Connector	(Straight Header-60 pin)		
1		1024-7130-00	Connector	50 Pin (M)	3M	3M54-5
1		1024-7199-00	Connector	15 Pin (F)	AMP	1-350244-9
1	B	1011-7130-03	Connector Brkt.			
1	fs	1093-7008-00	Stud Fastener		Southco	82-11240-16
2	B	1023-7007-01	Insulator Strip			
4		1032-7006-00	Transistor Pads		Bodine Electric	3012
14	fs	1108-0472-00	Resistor	4.7K 1/4 W		
2	fs	1108-0473-00	Resistor	47K 1/4 W		
1	fs	1108-0105-00	Resistor	1 M 1/4 W		

INSTRUMENT TITLE Board I (Horizontal) MODEL 1090A/AR

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	fs	1108-0224-00	Resistor	220K 1/4 W		
1	fs	1108-0101-00	Resistor	100 Ohm 1/4 W		
6	fs	1108-0471-00	Resistor	470 Ohm 1/4 W		
2	fs	1108-0330-00	Resistor	33 Ohm 1/4 W		
6	fs	1108-0103-00	Resistor	10K 1/4 W		
14	fs	1108-0102-00	Resistor	1K 1/4 W		
1	fs	1108-0332-00	Resistor	3.3K 1/4 W		
4	fs	1103-0273-00	Resistor	27K 1W		

INSTRUMENT TITLE Board II (Vertical) MODEL 1090 A/AR

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	000-7432-06	P. C. Board			
6		1134-7174-00	I.C.		T.I.	SN74S287N
2	B	1134-7204-00	I.C.		T.I.	SN74LS02N
2		1134-7128-00	I.C.		T.I.	SN74LS00
4		1134-7086-00	I.C.		T.I.	SN74L00N
5		1134-7092-00	I.C.		T.I.	SN74L08N
2	B	1134-7223-00	I.C.		T.I.	SN74LS298
2		1134-7190-00	I.C.		T.I.	SN74Z08N
1		1134-7089-00	I.C.		T.I.	SN74L20N
2		1134-7060-00	I.C.		T.I.	SN7474N
11		1134-7132-00	I.C.		T.I.	SN74LS74N
2		1134-7145-00	I.C.		T.I.	SN74LS05N
2		1134-7138-00	I.C.		T.I.	SN74L42N
2		1134-7094-00	I.C.		T.I.	SN74193N
2		1134-7064-00	I.C.		T.I.	SN7442N
8		1134-7137-00	I.C.		T.I.	SN74LS253N
2		1134-7157-00	I.C.		T.I.	SN74LS04
5		1134-7087-00	I.C.		T.I.	SN74L04N

INSTRUMENT TITLE Board II (Vertical) MODEL 1090A/AR

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
2		1134-7102-00	I.C.		T.I.	SN74LS83N
5		1134-7181-00	I.C.		T.I.	SN74L74N
1	B	1134-7222-00	I.C.		T.I.	SN74LS90
3		1134-7068-00	I.C.		T.I.	SN74L90N
1		1134-7155-00	I.C.		T.I.	SN74LS153
1		1023-7002-00	Capacitor	1000 pfd		DM15102J
1		1023-7003-00	Capacitor	500 pfd		
1		1023-7187-00	Capacitor	680 pfd @ 500V	Arco	DM-151681J
4		1023-7111-00	Capacitor	4.7 @ 10V		
1		1023-0292-00	Capacitor	22 @ 15 V		
2		1023-7151-00	Capacitor	.05 @ 50 V		
3		1023-7004-00	Capacitor	47 pfd		CM05FD
2		1023-7001-00	Capacitor	100 pfd		
13		1022-7011-00	Diode		Sylvania	1N270
4	fs	1024-7080-00	Connector	16 Pin	3M	3416
7		1024-7159-00	I.C. Socket			
1		1024-7145-00	Connector		3M	3428
20		1024-7147-00	Straight Pin Header			SS65274-2

INSTRUMENT TITLE Board II (Vertical) MODEL 1090A/AR

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
4	B	1134-7217-00	I.C.	cmos	Fairchild	34021
2	B	1134-7218-00	I.C.	cmos	Fairchild	34518
2	B	1134-7219-00	I.C.	cmos	Fairchild	34028
1	B	1134-7220-00	I.C.	cmos	Fairchild	34040
2	B	1134-7221-00	I.C.	cmos	Fairchild	34512

INSTRUMENT TITLE Converter Board MODEL 1090 A / AR

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7469-00	Convertor Bd.			
1		1134-7057-00	Op. Amp.		T.I.	SN72741P
1		1134-7115-00	Timer		Signetics	NE555V
1		1023-7020-00	Capacitor	2000 pfd	Elmenco	
2		1023-7015-00	Capacitor	.01 uf @ 2000 V	Sprague	
1		1023-7108-00	Capacitor	.1 uf @ 200 V	Sprague	
1		1023-7113-00	Capacitor	.1 @ 250 V	Seacor	
1		1023-7073-00	Capacitor	1. uf @ 200 V	TRW	
2		1023-7016-00	Capacitor	2.2 uf @ 20 V	Kemet	
1		1023-7075-00	Capacitor	6.8 uf @ 35 V	Kemet	
1		1023-0292-00	Capacitor	22 uf @ 15 V	Kemet	
3		1023-7069-00	Capacitor	50 uf @ 50 V	Sprague	
1		1023-7035-00	Capacitor	100 uf @ 25 V	Sprague	
1		1023-7112-00	Capacitor	220 uf @ 10 V	Comp. Corp.	
2		1023-7086-00	Capacitor	500 uf @ 24 V	Sprague	
1	B	1102-7001-00	Varistor		General Ele.	V-275LA20A

INSTRUMENT TITLE Converter Board MODEL Power Supply 1090 A/AR

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
8	fs	1022-7084-00	Diode		ITT	600
1		1022-7072-00	Diode		ITT	1N4006
12		1022-7008-00	Diode		ITT	1N4004
1		1022-7081-00	Diode		Motorola	1N4937
1		1022-7030-00	Diode	56 V	Motorola	1N5232B
2	C	1022-7041-00	Diode	6.2 V	Motorola	1N823
2		1022-7065-00	Diode	140 V	Motorola	1N5273B
2		1022-7066-00	Diode	200 V	Motorola	1N5281B
1		1022-7068-00	Diode		Motorola	1N5760
1		1022-7070-00	Diode		Semtech	S2F
2		1022-7071-00	Diode	35M2	Semtech	3SM2
1		1021-0146-00	Transistor		Fairchild	2N3569
3		1021-7022-00	Transistor		Motorola	2N3903
2		1021-7038-00	Transistor		Motorola	2N5978
1		1021-7049-00	Transistor		Delco	DTS-723
1		1026-7001-00	Trimpot	2K	Weston	
2		1201-4121-00	Prec. Resistor	4.12 K 1%	IRC	

INSTRUMENT TITLE Converter Board MODEL Power Supply 1090A/AR

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1201-6191-00	Prec. Resistor	6.19 K 1%	IRC	
1		1201-1963-00	Prec. Resistor	196 K 1%	IRC	
1		1201-5233-00	Prec. Resistor	523 K		
1		1101-0330-00	Resistor	33 ohm 1/2 W	Allen Bradley	
1		1106-7027-00	Resistor	36 ohm 2 W	Ohmite	
1		1106-7028-00	Resistor	68 K 2 W	IRC	
1		1108-0152-00	Resistor	1.5 K 1/4 W		
1		1019-7046-00	L. V. Transformer		Aguirre	
1		1067-7002-00	Transformer Core	(Red and Black)	Magnetics	55930A2
6		1019-7045-00	Choke Coil	100 ohm	Swanson Elec.	
1	B	1098-7026-01	Heat Sink		Use Wakefield 623 K as matl.	
1		1101-0471-00	Resistor	470 ohm 1/2 W	Allen Bradley	
1		1024-7196-00	Pin Header	15 Circuit	Amp	9-350268-1
1	B	1042-7045-00	Transistor Cover		Thermalloy	8903N
4			Threader Standoff	#6 x 3/8" O.L. x 1/4" O.P.		

PARTS LIST

INSTRUMENT TITLE Main Frame MODEL 1090A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1081-7007-00	Cabinet		Hubbard	
2	B	1042-7024-00	Side Covers	(Same as 1090)	Arvin	
1	B	1042-7027-01	Bottom Pan			
1	B	1268-7018-00	Stand Assembly		Buckeye	MP4000B-2
1		1049-7001-00	Handle & Dress Cover		Phil.	1776-354-254 (156)
1	B	1027-7003-00	CRT		Inter-Tech. Group	D14-170-GH
1	B	1044-7033-00	CRT Shield		Interchangeable with 1044-7016-00)	
4	fs	1093-7007-00	Skin Retainer		Southco	82-47-112-15
1	B	1268-7015-00	Upper Front Panel Latch		Richlind	
1	B	268-7016-00	Panel Retaining Clip			
1	fs		Panel Latch Screws			
4		1116-7019-00	C. B. Support	(Plastic)	Richloc	LCBS-6
				Anchor Blk. (1)		(1) AB-E-B
				Shim Plate (2)		(2) SPE-8-5
				Latch Nut (1)		(1) LH-8
1	B	1009-7049-00	Spacer/CRT		(Required with 1044-7033-00 CRT shield)	
2		1011-7084-00	Brkt./Bottom Pan			
4	fs	1088-7008-00	1/4 Turn Stud	(.240)	Southco	82-11-240-16

INSTRUMENT TITLE Main Frame MODEL 1090A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
5	fs	1093-7001-00	1/4 Turn Retaining Ring		Southco	
1	B	1011-7142-00	Center Support Bracket			
1	B	1116-7020-00	Support		Richloc	LCBS-20N
2		1011-7084-00	Support Bracket	(Bottom Pan)		
1	fs	1093-7010-00	1/4 Turn Stud	(160)	Southco	82-11-160-16
3		1068-7042-00	Plate	Danger H.V.		
4	B	1116-7003-00	Standoffs	(To hold Blanking Board)		
1	B	1042-7049-02	Blanking Board Cover			
1	B	1042-7048-02	Regulator Board Cover			

PARTS LIST

INSTRUMENT TITLE Front Panel MODEL 1090A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1068-7132-00	Escutcheon			
1	B	1068-7141-01	Sub-Panel			
1		1268-7013-00	CRT Bezel			
1	B	1164-7003-00	CRT Graticule	(Blue)		
1		1025-7185-00	Power Switch	Include Black Dress Nut	Licon	01-700135
3		1025-7155-00	Rotary Switch			
4		1025-7184-00	Slide Switch		C&W	GF1235PST
2		1025-7180-00	Push Button	(Momentary)	C&K	8531
2		1025-7187-00	Rocker Switch		C&K	7101J502GE-2
2		1025-7181-00	Paddle Switch		C&K	7213J602GE-2
2		1025-7186-00	Push Button	(Momentary)	C&K	8121J
2		NO Stock #	Cap or Button (Used with switch #8121J)		C&K	7892-2
6		NO Stock #	Bezel (Used with switches #8121J, 7101J502GE-2, 7213J602GE-2)		C&K	7890-2
1		1022-7079-00	LED		Fairchild	FLV110
2			Dress Nut		C&K	A7807
1	B	1063-7001-00	Strain Relief	(Cable Bridge)	Richco Plastics Co.	FCC-10-3
1		1040-7026-00	Cable Clip			
1		1161-7000-00	LED Holder		Hall-Mark	FLS010

INSTRUMENT TITLE Front Panel MODEL 1090A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1024-7217-00	Pin Housing	4 Pin	Amp	
3		1045-7023-00	Knob		Buckeye	PS-50-BL-1
1		1268-7016-00	Panel Retaining Clip			
1			Panel Latch Screw Binder Hd. Screw	6-32 x 5/16"		

PARTS LIST

INSTRUMENT TITLE 1090A MODEL Lower Rear Panel

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1068-7147-02	Rear Panel (Lower)			
1		1114-7004-00	Filter		Corcom	2K3
A.R.	B	1072-7005-00	Fan	115 V	Amp	760-99XM-182 1115
A.R.	B	1072-7006-00	Fan	220 V	Amp	760-99XM-182 11220
1	B	1042-7044-02	Convertor Cover			
1	B	1023-7167-00	Capacitor	11,500 uf @ 10 V	Mepco-Electra	139C10JP1152
2	B	1040-7037-00	Capacitor Clip		Richco	V-1009
1	B	1040-7038-00	Capacitor Clip		Richco	V-1010
1		1067-7002-00	Transformer Core	(Brown & Black)	Magnetics	55930-A2
1		1022-7102-00	Bridge Rectifier		Varo	VH847
1	B	1098-7023-00	Heat Sink Diode			
1		1022-7085-00	Diode		Motorola	1N5827
4	B	1009-7044-00	Threaded Standoff	#6 x 1- 7/8 L.L. 1/4" O.D. Chromed Brass		
2	fs		Rotary Latch Nut		Paneloc	LN-8
4	fs		Rotary Latch Shim		Paneloc	SPE-8-5
2	fs		Rotary Latch Anchor Block		Paneloc	A8-E-8
1		1085-7038-00	Line Cord		Switchcraft	

INSTRUMENT TITLE 1090A MODEL Lower Rear Panel

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1085-7039-00	Fan Cord		Amphenol	
1	B	1024-7215-00	Connector/AC	(Combination)	Corcom	
1		1024-7216-00	Socket Housing	4 Pin	Amp	1-350 240-9
1	fs		Grommet			
8	fs	1015-7025-00	Pin	(F)	Amp	350186-2
4	fs	1015-7026-00	Pin	(M)		350185-2
1	B	1017-7015-00	Name Plate	AC Receptacle		
2	B	1023-7166-00	Capacitor	100 uf @ 250 V	WBR-100-250	

PARTS LIST

INSTRUMENT TITLE 1090A MODEL Rear Panel (Upper)

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1068-7149-09	Upper Rear Panel			
2			Rotary Latch Nut		Paneloc	LN-8
4			Rotary Latch Shim		Paneloc	SPE-8-5
2			Rotary Latch Anchor Block			A8-E-8
1		1024-7065-00	Connector	44 Pin	Cinch	50-44-A-30
1		1024-7217-00	Socket Housing	4 Pin (F)	Amp	
2		1024-7214-00	Connector	BNC (Insulated)		31-010
1	B	1042-7046-00	I/O Cover			
2	B	1093-7015-00	Fastener	(I/O Cover)		
2	fs		Cable Clamps	#54		
1		1034-7125-00	Guide Key		Cinch	50 PK 2
4		1009-7043-01	Threaded Standoff	#8 x 3/4" O.L.		CSOS-8-32-12
2		1134-7003-00	Captive Screw			

PARTS LIST

INSTRUMENT TITLE 1090A Belt Connector Kit MODEL 1090A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
6		1024-7144-00	20 Pin (F) Conn.	3421	3M	
1		1024-7129-00	50 Pin (F) Conn.	3415-001	3M	
2		1024-7142-00	50 Pin (F) Conn.	3415	3M	
1		1024-7130-00	50 Pin (M) Conn.	3426	3M	
1		1024-7210-00	16 Pin (M) Conn.	3416	3M	

PARTS LIST

INSTRUMENT TITLE Blanking Board MODEL 1090A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7520-01	P. C. Board			
1		1021-7018-00	Transistor		Motorola	2N3905
1		1021-7022-00	Transistor		Semiconductor Spec.	2N3903
1		1021-7003-00	Transistor		I. I.	2N3725
1	B	1021-7051-00	Transistor		ITT	2N2905A
1		1023-7110-00	Capacitor	22 @ 35V		
1		1023-7011-00	Capacitor	5 uf @ 150V		
1		1024-7147-00	Straight Pin Header 19 Pin (M)			SS65174-2
1		1023-7002-00	Capacitor	1000 pfd		
1		1024-7113-00	Crt. Pin Socket			
2		1023-7015-00	Capacitor	.01 @ 2000V		
2		1024-7120-00	Crt. Rubber Ins.		Cinch	
1		1023-7135-00	Capacitor	4.7 uf @ 50V		
1		1023-7151-00	Capacitor	.05 @ 50V	Arco	TCD-503
5		1015-7003-00	Pin		Amp	60618-1
1		1024-7198-00	Socket Housing	9 Pin	Amp	1-350242-9

PARTS LIST

INSTRUMENT TITLE 1090A/AR MODEL Blanking Board

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7520-01	P. C. Board			
1		1021-7018-00	Transistor			2N3905
1		1021-7022-00	Transistor			2N3903
1		1021-7003-00	Transistor			2N3725
1	B	1021-7051-00				2N2905A
1		1023-7110-00	Capacitor	22 @ 35V		
1		1023-7011-00	Capacitor	5 uf @ 150V		
1		1024-7147-00	Straight Pin Header 19 Pin (M)			SS65274-2
1		1023-7002-00	Capacitor	1000 pfd		
1		1024-7113-00	Crt. Pin Socket			
2		1023-7015-00	Capacitor	.01 @ 2000V		
2		1024-7120-00	Crt. Rubber Ins.		Cinch	
1		1023-7135-00	Capacitor	4.7 uf @ 50V		
1		1023-7151-00	Capacitor	.05 @ 50V		TCD-503
5		1015-7003-00	Pin			60618-1
1		1024-7198-00	Socket Housing	9 Pin	Amp	1-350242-9

PARTS LIST

INSTRUMENT TITLE 1090AR MODEL Main Frame

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1129-7005-03	Cross Frame			
1	B	1034-7123-01	Plug-In Guide			
1	B	1042-7043-00	Top Cover	2-0-180 (3) per 1/4 turn 2-0-160 (3) per	Southco (6)	82-32-101-17 Retng
1	B	1042-7042-00	Bottom Cover			
2	B	1034-7110-00	Side Rail			
2	B	1084-7002-00	Trim Channel			
2	B	1042-7041-00	Trim Channel Cover			
1	B	1011-7116-00	Mounting Brkt.	(Right)		
1	B	1011-7146-00	Mounting Brkt.	(Left)		
2	B	1062-7015-00	Mounting Block			
2	B	1116-7018-00	Front Panel Support			
1	B	1020-7010-01	Front CRT Mntg.	Chassis		
1		1027-7003-00	CRT			
1		1044-7033-00	CRT Shield			
3			Captive Fastener	(.160 Stud Length)	Southco	
3			Captive Fastener	(.180 Stud Length)	Southco	
1	B	1268-7020-00	Cabinet Stand	(large)	Buckeye	
3			Receptacle	1/4 turn		82-47-104-15

INSTRUMENT TITLE 1090AR MODEL Main Frame

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
2	B	1068-7155-00	Mntg. Ear Esc.			
1	B	1042-7049-00	Blanking Brd. Cover			
1			Self Clinching Fasteners	9/16"	PEM	SOS-632-18
3			Self Clinching Fasteners	3/4"	PEM	SOS-632-24

INSTRUMENT TITLE 1090AR MODEL Front Panel

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1068-7139-02	Front Panel			
1		1268-7013-00	CRT Bezel			
1	B	1164-7003-00	CRT Graticule	(Blue)		
1		1025-7185-00	Power Switch		Licon	
3		1025-7155-00	Rotary Switch		CRL	
2		1025-7181-00	Paddle Switch		C&K	
2		1025-7213-00	Toggle Switch		J.F.I.	LFH-123
2		1025-7180-00	Push Button Switch		C&K	8531
2		1025-7186-00	Push Button Switch		C&K	8121?
3		1025-7187-00	Rocker Switch		C&K	7101J50
1		1025-7196-00	Paddle Switch		C&K	7101J60
1		1025-7079-00	LED			FLV110
1		1161-7000-00	LED Adapter			FL5010
2	B	1084-7003-00	Trim Channel	6.718 O.L. (purchased in 60" strips)	Southco	98-10-XXX-13
4	B		Retainers		Southco	(included with above)
4		1010-7009-00	Dress Nut	(Black Anodized)	J.B.T.	W-NU-20
3		1045-7023-00	Knob			
1		1024-7217-00	Connector	4 Pin (M)	AMP	1-350233-9

PARTS LIST

INSTRUMENT TITLE 1090AR MODEL Front Panel

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1011-7096-00	Strain Relief			
1	B	1011-7131-00	FRT Cable Brkt.			

PARTS LIST

PAGE ____ OF ____

INSTRUMENT TITLE 1090AR MODEL Rear Panel

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1068-7138-06	Rear Panel			
1	B	1023-7167-00	Capacitor		Mepco Electra	129C10JP1152
2		1040-7166-00	Capacitor	100 mfd @ 250V	CD	
2		1040-7037-00	Capacitor Clip		Richco	V-1009
1		1040-7038-00	Capacitor Clip		Richco	V-1010
1		1022-7102-00	Bridge Rectifier		Varo	VH847
2	B	1072-7005-00	Fan/115V			
2		1072-7006-00	Fan	220V	Amphenol	760-99XM-182 11220
1		1085-7058-00	Line Cord			
2		1085-7059-00	Fan Cord			
1	B	1042-7046-02	I/O Cover			
1		1067-7002-00	Transformer Core	(Brn. & Blk.)	Magnetics	SS930-A2
1		1022-7085-00	Diode		Motorola	1N5827
1	B	1024-7215-00	Connector/AC	(combination)	Corcom	6J1
1		1114-7004-00	Filter		Corcom	2K3
1	B	1098-7023-00	Bracket (heatsink for diode)			
2	B	1116-7023-00	Support/P.C.B.		Richloc	LCBS-6N
1		1024-7065-00	Connector	44 Pin	Cinch	50-44-A-30

INSTRUMENT TITLE 1090AR MODEL Rear Panel

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1024-7217-00	Socket Housing	4 Pin (F)	AMP	
2		1024-7214-00	Connector	BNC (insulated)		
1		1011-7137-01	Brd. Mounting Brkt.			
2			Thrd. Standoff			
1	B	1042-7044-01	Converter Cover		Richlind	
4			Rotary Latch Shim		Paneloc	APE-8-5
4			Threaded Standoff	#6 x 1 7/8 O.L. 1/4 O.D. Charm Brass		
1	B	1044-7030-01	H. V. Shield			
2	B	1093-7013-00	Fastener	(I/O Cover)		
2		1134-7003-00	Captive Screws			
2	fs		Cable Clamps	#54		
1	B	1017-7015-00	Name Plate	AC Receptacle		
2			Standoff	5/8"	PEM	SOS 632 20

PARTS LIST

INSTRUMENT TITLE Sub. Asmb. Structure MODEL Model 93A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1			P. C. Board	Mother Board		
2			P. C. Board	Digitizer Board		
2			P. C. Board	Memory Board		
1			P. C. Board	Pulser Board		
1			P. C. Board	Control Board		
1			Front Panel			
1			Final Asmb.			

PARTS LIST

INSTRUMENT TITLE Model 93A MODEL Final Assembly

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1034-7092-00	Plug in Right Side		Kelsch	
1		1034-7093-00	Plug in Left Side		Kelsch	
4		1034-7096-00	Elco Guide		Elco	
1		1068-7146-00	Plug in Rear Panel			
1	B	1011-7110-02	Latch Brkt.			

INSTRUMENT TITLE Model 93A MODEL Front Panel

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1068-7126-03	Front Sub Panel			
1	B	1068-7122-03	Front Panel Esc.			
1	B	1020-7009-02	Chassis (Box)			
1		1025-7180-00	Momentary Push Switch		C & K	8531
1		1026-7017-00	Potentiometer			
1		1024-7115-00	Connector	5 Contact	Switchcraft	
1		1024-0589-00	Connector	BNC	Amp	
4		1022-7079-00	LED		Fairchild	FLV 110
1	B	1011-7104-01	Switch Bracket		Richlind	
1	C	1045-7016-00	Knob		Buckeye	
3	C	1045-7023-00	Knob		Buckeye	
1		1025-7167-00	Switch	DPDT Slide	Alco Switch	MSC200
2		1025-7213-00	Switch, Toggle		J.B.T.	LFH-123
3		1025-7127-00	Switch & Button	SPDT Push Button	C & K	
1		1025-7155-00	Switch	1 Pole B.C. Rotary	CRL	
1		1025-7182-00	Switch	2 Pole 5 Pos. Rotary	CRL	P.S. 105
1		1025-7179-00	Switch	2 Pole 3 Pos. Rotary	CRL	P.S. 109
1		1023-7113-00	Capacitor	.1 @250V	Seacor	

PARTS LIST

INSTRUMENT TITLE Model 93A MODEL Front Panel

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
3		1010-7009-00	Dress Nut			W-NU-20
1		1093-7014-00	Adjustable Grip Latch		Southco	27-10-301-30C

INSTRUMENT TITLE Model 93A MODEL Pulser Board

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7483-01	P.C. Board			
2		1134-7135-00	I.C.		T.I.	7483A
1	C	1134-7086-00	I.C.		T.I.	7400
8	C	1134-7112-00	I.C.		T.I.	74S74
1	C	1134-7104-00	I.C.		T.I.	74S00
4	C	1134-7128-00	I.C.		T.I.	74LS00
11	C	1134-7132-00	I.C.		T.I.	74LS74
22		1022-7060-00	Diode		Motorola	MBD101
4	C	1021-7018-00	Transistor		Motorola	2N3905
29	C	1021-7047-00	Transistor		Motorola	2N5224
2		1026-7057-00	Trimpot	5K	Helitrim	89P
1	B	1191-7046-00	Crystal	40 MHz	Marden Electronics	HC 18/U
4	C	1201-1051-00	Prec. Resistor	1.05K 1%	I.R.C.	
2	C	1201-3161-00	Prec. Resistor	3.16K 1%	I.R.C.	
10	C	1201-2492-00	Prec. Resistor	24.9K 1%	I.R.C.	
4		1021-7022-00	Transistor		Motorola	2N3903
1		1134-7191-00	I.C.		T.I.	74196
22	fs	1108-3302-00	Resistor	33K 1/4 Watt	A.B.	

PARTS LIST

INSTRUMENT TITLE Model 93A MODEL Pulser Board

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
2	fs	1108-0331-00	Resistor	33 Ohm 1/4 Watt	A.B.	
1	fs	1108-3301-00	Resistor	3.3K 1/4 Watt	A.B.	
1	fs	1108-2201-00	Resistor	2.2K 1/4 Watt	A.B.	
2	fs	1108-0221-00	Resistor	220K 1/4 Watt	A.B.	
3	fs	1108-0102-00	Resistor	1K 1/4 Watt	A.B.	
2	fs	1108-0101-00	Resistor	100 Ohm 1/4 Watt	A.B.	
1	fs	1108-0153-00	Resistor	15K 1/4 Watt	A.B.	
4	fs	1108-0472-00	Resistor	4.7K 1/4 Watt	A.B.	
2	fs	1108-0473-00	Resistor	47K 1/4 Watt	A.B.	
18	fs	1108-0181-00	Resistor	180 Ohm 1/4 Watt	A.B.	
5	C	1023-7024-00	Capacitor	.01 100V	Sprague	
1	C	1023-7028-00	Capacitor	.68 mfd @ 35V	Kemet/Hall Mark	
3	C	1023-7001-00	Capacitor	100 pfd	Elmenco	
1	C	1023-7106-00	Capacitor	10 pfd	Elmenco	
2	N/C	1023-7151-00	Capacitor	.05 @ 50V		
2		1023-7080-00	Capacitor	3.3 pfd		

INSTRUMENT TITLE Model 93A MODEL Control Board

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7481-03	P. C. Board			
5	C	1134-7086-00	I. C.		T. I.	74L00N
1	B	1000-7481-05	P. C. Board			
1	C	1134-7097-00	I. C.		T. I.	74121
1	C	1134-7095-00	I. C.		"	7410
3	C	1134-7081-00	I. C.		"	74L74
1		1134-7093-00	I. C.		"	74L153
5	C	1134-7132-00	I. C.		"	74LS74
2	C	1134-7018-00	I. C.		"	7400
2	C	1134-7058-00	I. C.		"	7402
4	C	1134-7114-00	I. C.		"	7408
2	C	1134-7060-00	I. C.		"	7474
1	C	1134-7075-00	I. C.		"	7486
1	C	1134-7102-00	I. C.		"	74LS83
1	B	1134-7195-00	I. C.		"	74S288
8	C	1023-7070-00	Capacitor	.02 @ 100V	Sprague	
1	C	1023-7002-00	Capacitor	1000 @ -5%	Sprague	

INSTRUMENT TITLE MODEL 93A MODEL Control Board

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
2	C	1023-7003-00	Capacitor	500 pf		
1		1134-7128-00	I.C.		T.I.	SN74LS00N
1	C	1023-7005-00	Capacitor	250 pf		
1	fs	1108-0102-00	Resistor	1/4 Watt 1K		
16	fs	Misc.	Resistors	1/4 Watt	A.B.	
1	C	1134-7088-00	I.C.	74L10	T.I.	
1		1023-0292-00	Capacitor	22 uf @ 15V		
1	fs	1108-0222-00	Resistor	2.2K 1/4W		
8	fs	1108-0103-00	Resistor	10K 1/4W		
1	fs	1108-0682-00	Resistor	6.8K 1/4W		

INSTRUMENT TITLE Model 93A MODEL Address Trigger & Sweep ("Mother Board")

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7482-02	P.C. Board			
1		1134-7058-00	I.C.		T.I.	7402
1		1134-7022-00	I.C.		T.I.	7490
2		1134-7079-00	I.C.		T.I.	74191
1		1134-7018-00	I.C.		T.I.	7400
2		1134-7086-00	I.C.		T.I.	74L00
2		1134-7087-00	I.C.		T.I.	74L04
2		1134-7092-00	I.C.		T.I.	74L98
2		1134-7093-00	I.C.		T.I.	74L153
4		1134-7132-00	I.C.		T.I.	74LS74
2		1134-7102-00	I.C.		T.I.	74LS83
1		1134-7127-00	I.C.		T.I.	72820
1		1134-7139-00	I.C.		MK5009P	Mostek
4		1023-7069-00	Capacitor	50 @50V	CDE	
3		1023-7035-00	Capacitor	100 @25V	CDE	
2		1023-7112-00	Capacitor	220 @ 10V	Kemet	
1		1023-7003-00	Capacitor	500 pp	Elmenco	
1		1023-7002-00	Capacitor	1000 pp	Elmenco	

INSTRUMENT TITLE Model 93A MODEL Address Trigger & Sweep ("Mother Board")

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1023-7001-00	Capacitor	100 pfd		
4		1023-7024-00	Capacitor	.01 mfd @100V	Sprague	
1		1023-7113-00	Capacitor	.1 @250V	Sprague	
1		1023-7118-00	Capacitor	.001 @200V	Sprague	
2		1022-7036-00	Diode	5226B	I.R.	
3		1022-7084-00	Diode	ITT 600	I.T.T.	
3		1021-7047-00	Transistor	2N5224	Motorola	
2		1021-7003-00	Transistor	2N3725	T.I.	
30			Resistor	Misc. 1/4 Watt	A.B.	
1		1134-7186-00	R.O.M.	74S288	T.I.	SUB 74188
1		1105-0620-00	Resistor	62 Ohm 2 Watt	A.B.	
1		1105-0270-00	Resistor	27 Ohm 2 Watt	A.B.	
1		1026-7055-00	Trimmer	1K	Helipot	89P
1		1201-4532-00	Prec. Resistor	45.3K	I.R.C.	
2		1201-3242-00	Prec. Resistor	32.4K	I.R.C.	
1		1201-6810-00	Prec. Resistor	6.81K	I.R.C.	
1		1201-1692-00	Prec. Resistor	16.9K	I.R.C.	
1		1201-2371-00	Prec. Resistor	2.37K	I.R.C.	

INSTRUMENT TITLE Model 93A MODEL Address Trigger & Sweep

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1201-4003-00	Prec. Resistor	400K	I.R.C.	
1		1022-7092-00	Regulator	MC1463R	Motorola	
2	B	1134-7187-00	Regulator	RC 723	ACA	
1		1024-7125-01	Connector	20 Pin	Cinch	50-20-B-10
4		1024-7243-00	Connector	80 Pin	Amp	530368-9
1		1101-0240-00	Resistor	1/2 watt 2.4 OHM		
1		1106-7032-00	Resistor	2 watt 390 OHM		
1		1106-7012-00	Resistor	2 watt 57 OHM		
2			Trimmer	2K		89PR
1			Trimmer	100 OHM		89PR
2			Transistor			2N2484
2			Capacitor	150	Elmenco	
3			Capacitor	.02 @100V	Elmenco	
3			Capacitor			
1		1024-7125-00	Connector	20 Pin	Cinch	50-20-B-10
1			Zener Diode	7.5V		1N5236
1		1101-0471-00	Resistor	1/2 Watt 470 OHM		

INSTRUMENT TITLE Model 93A MODEL Digitizer Board (Reg. (2) Boards per plug-in)

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7443-00	P. C. Board	Same P.C.B. as M93	Circuit Science	
1		1134-7157-00	I. C.		T. I.	SN74S04N
4		1134-7104-00	I. C.		T. I.	SN74LS00
10		1134-7132-00	I. C.		T. I.	SN74LS74N
2		1134-7135-00	I. C.		T. I.	SN7483N
40		1022-7060-00	Diode		Motorola	MBD101
2		1022-7095-00	Diode			1N5309
4		1021-7006-00	Transistor		T. I.	1N2484
10		1021-7018-00	Transistor		Motorola	2N3905
31		1021-7027-00	Transistor		Motorola	2N4265
8		1021-7022-00	Transistor		Motorola	2N3903
1		1021-7042-00	Transistor		Motorola	2N5771
7		1026-7055-00	Pot	1K	Helitrim	89P
4		1026-7056-00	Pot	2K	Helitrim	89P
9		1201-1051-00	Prec. Resistor	1.05K 1%	I.R.C.	
5		1201-3161-00	Prec. Resistor	3.16K 1%	I.R.C.	
7		1201-2432-00	Prec. Resistor	24.3K 1%	I.R.C.	
10		1201-2492-00	Prec. Resistor	24.9K 1%	I.R.C.	

INSTRUMENT TITLE Model 93A MODEL Digitizer Board
(Reg. (2) Boards per plug-in)

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTUER	MFG. NUMBER
1		1108-0279-00	Resistor	2.7 Ohm 1/4 Watt	A. B.	
13		1108-0181-00	Resistor	180 Ohm 1/4 Watt	A. B.	
4	fs	1108-0332-00	Resistor	3.3K 1/4 Watt	A. B.	
14	fs	1108-0333-00	Resistor	33K 1/4 Watt	A. B.	
10	fs	1108-0473-00	Resistor	47K 1/4 Watt	A. B.	
4	fs	1108-0222-00	Resistor	2.2K 1/4 Watt	A. B.	
5	fs	1108-0223-00	Resistor	22K 1/4 Watt	A. B.	
2	fs	1108-0224-00	Resistor	220K 1/4 Watt	A. B.	
1	fs	1108-0392-00	Resistor	3.9K 1/4 Watt	A. B.	
2	fs	1108-0474-00	Resistor	470K 1/4 Watt	A. B.	
4	fs	1108-0472-00	Resistor	4.7K 1/4 Watt	A. B.	
2	fs	1108-0103-00	Resistor	10K 1/4 Watt	A. B.	
3	fs	1108-0100-00	Resistor	10 Ohm 1/4 Watt	A. B.	
2	fs	1108-0682-00	Resistor	6.8K 1/4 Watt	A. B.	
1	fs	1108-0470-00	Resistor	47 Ohm 1/4 Watt	A. B.	
1	fs	1108-0822-00	Resistor	8.2K 1/4 Watt	A. B.	
3	fs	1108-0102-00	Resistor	1K 1/4 Watt	A. B.	
5	fs	1108-0331-00	Resistor	330 Ohm 1/4 Watt	A. B.	

PARTS LIST

INSTRUMENT TITLE Model 93A MODEL Digitizer Board

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
3		1023-7113-00	Capacitor	0.1 mfd @ 250	Seacor	
2		1023-7004-00	Capacitor	47 Pfd	Elmenco	
3		1023-7001-00	Capacitor	100 Pfd	Elmenco	
1		1023-7003-00	Capacitor	500 Pfd	Elmenco	
12		1023-7024-00	Capacitor	.01 @ 100V	Sprague	
3		1023-7070-00	Capacitor	.02M @ 100V	Sprague	
4		1023-7151-00	Capacitor	.05 mf @ 50V	Sprague	
2		1023-7106-00	Capacitor	10 Pfd	Centralab	
1		1023-7080-00	Capacitor	3.3 Pfd	Centralab	
14		1108-0333-00	Resistor	33K 1/4 Watt		
3		1108-0181-00	Resistor	180 Ohm 1/4 Watt		
1		1026-7054-00	Pot	500 Ohm	Helitrim	89P

PARTS LIST

INSTRUMENT TITLE Model 93A MODEL Memory Board NOTE: 2 Boards Required/Plug-in

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7484-01	P. C. Board		Circuit Science	
1	C	1134-7157-00	I.C.		T.I.	74S04
6		1134-7137-00	I.C.		T.I.	74LS253
24		1134-7151-00	I.C. (Sh. Regst.)	2533 DC	Fairchild	A6C3355192
4	C	1023-0292-00	Capacitor	22 mfd @ 15V	Kemet	
7		1134-7132-00	I.C.		T.I.	SN74LS74N
6		1023-7070-00	Capacitor	.02 mfd @ 100V		
1		1023-7001-00	Capacitor	100 pfd		

PARTS LIST

INSTRUMENT TITLE Sub-Assembly MODEL M-94A Plug-in

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1			Front Panel Asmb.			
1			Final Assembly			
1			ADC Board (8 Bit)			
1			Memory Board Asmb.			
1			Mother Board Asmb.			

PARTS LIST

INSTRUMENT TITLE Final Asmb. MODEL M-94A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1034-7092-00	Plug-in Right Side			
1		1034-7093-00	Plug-in Left Side			
2		1034-7096-00	Elco Guide			
1		1068-7146-00	Plug-in Rear Panel			
1	B	1093-7014-00	Grip Latch		Southco	27-10-301-30C
2		1034-7096-01	Elco Guide			

INSTRUMENT TITLE Front Panel MODEL M-94A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1068-7154-01	Front Sub Panel			
1	B	1068-7153-01	Front Esc.			
1	B	1020-7011-00	Chassis	(1 Wide Box)	Richlind	
1		1025-7180-00	Switch		C & K	8531
3		1025-7213-00	Switch (Toggle)		J.B.T.	LFH-123
3		1025-7127-00	Switch	(Push Button) SPDT	C & K	
1		1025-7179-00	Switch	3 Pol. 3 Pos.	Centralab	PA-166-0180AA
1		1025-7167-00	Switch	DPDT Slide	Alco Switch	MS 2200
1		1023-7113-00	Capacitor	.1 uf @ 250 V		
1		1026-7017-00	Trimpot	100 K	Centralab	JMP 104
4		1022-7079-00	LED		Fairchild	FLV 110
1		1024-0589-00	Connector	BNC	Amphenol	
1		1011-7104-01	Switch Bracket		Richlind	
1		1024-7115-00	Connector	5 Contact	Switchcraft	201676-1
1		1161-7000-00	LED Holder		Hall-Mark	FLS010
1	C	1045-7026-00	Knob		Buckeye	
2		1025-7155-00	Switch	12 Pos. Binary	Centralab	PA 166-011
3	C	1045-7023-00	Knob		Buckeye	
3		1010-7009-00	Dress Nut		J.B.T.	W-NU-20

INSTRUMENT TITLE Mother Board MODEL M-94A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1000-7495-00	Mother Board			
2		1134-7031-00	I.C.		T.I.	SN74L74N
1		1134-7088-00	I.C.		T.I.	SN74L10N
4		1134-7118-00	I.C.		T.I.	SN7408N
2		1134-7060-00	I.C.		T.I.	SN7474N
1		1134-7018-00	I.C.		T.I.	SN7400N
1		1134-7075-00	I.C.		T.I.	SN7486N
1		1134-7087-00	I.C.		T.I.	SN74L04N
2		1134-7058-00	I.C.		T.I.	SN7402N
6		1134-7132-00	I.C.		T.I.	SN74LS74N
1		1134-7127-00	I.C.		T.I.	SN72820N
1		1134-7157-00	I.C.		T.I.	SN74S04N
5		1134-7112-00	I.C.		T.I.	SN74S74N
2		1134-7195-00	I.C.		T.I.	SN74S288N
2		1134-7093-00	I.C.		T.I.	SN74L153N
1		1134-7137-00	I.C.		T.I.	SN74LS253N
1		1134-7097-00	I.C.		T.I.	SN74121N
2		1134-7053-00	I.C.		T.I.	SN7404N

INSTRUMENT TITLE Mother Board MODEL M-94A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1134-7135-00	I.C.		T.I.	SN7483AN
2	B	1134-7210-00	I.C.	Ceramic	Fairchild	93191 D.C.
3		1134-7191-00	I.C.		T.I.	SN74196N
1		1134-7104N	I.C.		T.I.	SN74S00N
1		1134-7101-00	I.C.		T.I.	SN74164N
1		1134-7161-00	I.C.		T.I.	SN74S153N
1		1134-7092-00	I.C.		T.I.	SN74L98
1		1134-7086-00	I.C.		T.I.	SN74L00N
1		1134-7139-00	I.C.		Mostek	MK 5009 P
1		1134-7188-00	I.C.		T.I.	SN74LS175N
1		1134-7124-00	I.C.		T.I.	SN74126N
6		1023-7070-00	Capacitor	.02 uf @ 100V		
5		1023-7024-00	Capacitor	.01 uf @ 100V		
1		1023-7106-00	Capacitor	10 pf (1k-V)		
1		1023-7110-00	Capacitor	22 uf @ 35V		
4		1023-7148-00	Capacitor	75 uf @ 50V		
2		1023-7112-00	Capacitor	220 uf @ 10V		
2		1023-0292-00	Capacitor	22 uf @ 15V		

INSTRUMENT TITLE Mother Board MODEL M-94A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
2		1023-7151-00	Capacitor	.05 uf @ 50V	Arco	TCD-503
1		1023-7075-00	Capacitor	6.8 uf @ 35V		
3		1023-7005-00	Capacitor	250 pf +/- 5%		
1		1023-7003-00	Capacitor	500 pf +/- 5%		
3		1023-7002-00	Capacitor	1000 pf +/- 5% 100V		
2		1021-7047-00	Transistor		Motorola	2N5224
1		1021-7022-00	Transistor		Semiconductor Spec.	2N3903
2		1021-7006-00	Transistor		T.I.	2N2484
1		1022-7092-00	Regulator		Motorola	MC 1463 R
1		1022-7111-00	Regulator		Motorola	MC -1469 R
6		1022-7008-00	Diode		ITT	1N4004
2		1022-7060-00	Diode		MBD	101
2		1022-7083-00	Diode		FDH	600
2		1026-7055-00	Trimpot	1K		89 PR
1		1026-7066-00	Trimpot	100 Ohm		89 PR
1		1026-7054-00	Trimpot	500 Ohm		89 PR
1		1191-7046-00	Crystal	40 MHZ		
2		1201-6810-00	Prec. Resistor	6.81 K		

INSTRUMENT TITLE Mother Board MODEL M-94A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
2		1201-4003-00	Prec. Resistor	400 K		
2		1201-4532-00	Prec. Resistor	45.3 K		
2		1024-7064-00	Connector	80 Pin		
1		1023-7001-00	Capacitor	100 +/- 5%		
1	fs	1108-0222-00	Carbon Resistor	2.2 K 1/4 W		
5	fs	1108-0470-00	Carbon Resistor	470 Ohm 1/4 W		
2	fs	1108-0152-00	Carbon Resistor	1.5 K 1/4 W		
1	fs	1108-0681-00	Carbon Resistor	680 Ohm 1/4 W		
1	fs	1108-0101-00	Carbon Resistor	100 Ohm 1/4 W		
13	fs	1108-0103-00	Carbon Resistor	10 K 1/4 W		
3	fs	1108-0472-00	Carbon Resistor	4.7 K 1/4 W		
4	fs	1108-0182-00	Carbon Resistor	180 Ohm 1/4 W		
3	fs	1108-0102-00	Carbon Resistor	1 K 1/4 W		
6	fs	1108-0223-00	Carbon Resistor	22 K 1/4 W		
1	fs	1108-0682-00	Carbon Resistor	6.8 K 1/4 W		
1	fs	1108-0683-00	Carbon Resistor	68 K 1/4 W		
1	fs	1108-0104-00	Carbon Resistor	100 K 1/4 W		
1	fs	1108-0105-00	Carbon Resistor	1 MEG 1/4 W		

INSTRUMENT TITLE Mother Board MODEL M-94A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	fs	1108-0331-00	Carbon Resistor	330 Ohm 1/4 W		
5	fs	1108-0100-00	Carbon Resistor	10 Ohm 1/4 W		
1	fs	1108-0221-00	Carbon Resistor	220 Ohm 1/4 W		
2		1022-7037-00	Zener Diode	5.1 V	Motorola	1N5231 B
2		1022-7036-00	Zener Diode	5.3 V	Motorola	1N5226 B

PARTS LIST

INSTRUMENT TITLE ADC Board (8 Bit) MODEL M-94 / M94A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7538-02	P.C. Board			
2		1134-7104-00	I.C.		T. I.	SN74S00N
2		1134-7102-00	I.C.		T. I.	SN74LS83N
4		1134-7162-00	I.C.		T. I.	SN74S175N
6		1134-7188-00	I.C.		T. I.	SN74LS175N
3		1134-7128-00	I.C.		T. I.	SN74LS00N
6		1023-7188-00	Capacitor	4.7 pf	Erie	301-000-C0H0-479C
5	B	1023-7171-00	Capacitor	47 pf @ 300 V	Arco	DM5EC470J
1	B	1023-7173-00	Capacitor	68 pf @ 50 V	Arco	DM5EY680J
4		1023-7024-00	Capacitor	.01 mfd @ 100 V		Type Z5U
1		1023-7176-00	Capacitor	15 pf @ 300 V	Arco	DM5CC150J
3		1023-7080-00	Capacitor	3.3 pf 1KV		
2		1023-7106-00	Capacitor	10 pf 1KV		
6		1023-7070-00	Capacitor	.02 @ 100 V		
1		1023-7001-00	Capacitor	100 pfd		
1		1023-7088-00	Capacitor	33 pfd		
46		1022-7096-00	Diode		Motorola	MBI-101
19		1022-7094-00	Diode		ITT	1N4150

INSTRUMENT TITLE ADC Board (8 Bit) MODEL M-94 / M94A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
2		1022-7034-00	Diode		Motorola	5227B
1		1022-7036-00	Diode		Motorola	5226B
16		1021-7042-00	Transistor		Fairchild	2N5771
7		1021-7047-00	Transistor		Motorola	2N5224
14		1021-7018-00	Transistor		Motorola	2N3905
9		1021-7055-00	Transistor		Motorola	MMT-73
3	B	1021-7056-00	Transistor		Motorola	MMT-2857
1		1216-7005-00	Prec. Resistor	49.9K 1% 1/20W		
14	B	1216-7000-00	Prec. Resistor	24.9K 1% 1/20W	Dale	MF 50
3	B	1216-7001-00	Prec. Resistor	499 Ohm (1%) 1/20W	Dale	MF 50
3	B	1216-7002-00	Prec. Resistor	2K (1%) 1/20W	Dale	MF 50
11	B	1216-7003-00	Prec. Resistor	150 Ohm (1%) 1/20W	Dale	MF 50
1		1216-7007-00	Prec. Resistor	1K (1%) 1/20W	Dale	MF 50
3		1216-7004-00	Prec. Resistor	7.5K 1% 1/20W	Dale	
3		1216-7006-00	Prec. Resistor	1.05 1% 1/20W		
6		1067-7005-00	Core		IGC	PR 6502-1
1	fs	1108-0100-00	Carbon Resistor	10 Ohm 1/4 W		
2	B	1217-7000-00	Carbon Resistor	330 Ohm 5% 1/8 W	A.B.	

PARTS LIST

INSTRUMENT TITLE ADC Board (8 Bit) MODEL M-94 / M-94A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
7	B	1217-7001-00	Carbon Resistor	4.7K 5% 1/8 W	A.B.	
7	B	1217-7002-00	Resistor	10K 5% 1/8 W	A.B.	
6	B	1217-7003-00	Carbon Resistor	15K 5% 1/8 W	A.B.	
22	B	1217-7004-00	Carbon Resistor	22K 5% 1/8 W	A.B.	
1	B	1217-7013-00	Resistor	100 Ohm 1/8 W		
3	B	1217-7005-00	Carbon Resistor	100K 5% 1/8 W	A.B.	
5	B	1217-7006-00	Resistor	1K 5% 1/8 W	A.B.	
5		1217-7011-00	Carbon Resistor	47K 1/8 W		
1		1217-7008-00	Carbon Resistor	220 Ohm 1/8 W		
2		1217-7009-00	Carbon Resistor	1.5K 1/8 W		
7		1217-7010-00	Carbon Resistor	33K 1/8 W		
11		1217-7007-00	Carbon Resistor	47 Ohm 1/8 W		
1		1217-7015-00	Resistor	680 Ohm 1/8 W		
1		1201-6819-00	Prec. Resistor	68.1 F 1% 1/8 W		
1		1201-3742-00	Prec. Resistor	37.4K 1% 1/8 W		
1		1201-2000-00	Prec. Resistor	200 Ohm 1% 1/8 W		
1		1201-4022-00	Prec. Resistor	40.2K 1% 1/8 W		
3		1108-0220-00	Resistor	22 Ohm 1/4 W		

INSTRUMENT TITLE ADC Board (8 Bit) MODEL M-94 / M-94A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
2		1108-0470-00	Resistor	47 Ohm 1/4 W		
1		1108-0101-00	Resistor	100 Ohm 1/4 W		
1		1108-0332-00	Resistor	3.3K 1/4 W		

PARTS LIST

INSTRUMENT TITLE Memory Board MODEL M-94A

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7493-01	Memory Board			
4		1134-7060-00	I.C.		T.I.	SN7474N
2		1134-7124-00	I.C.		T.I.	SN74126N
1		1134-7188-00	I.C.		T.I.	SN74LS175N
2		1134-7168-00	I.C.		T.I.	SN74123N
1		1134-7112-00	I.C.		T.I.	SN74S74N
4		1134-7137-00	I.C.		T.I.	SN74LS253N
1		1134-7114-00	I.C.		T.I.	SN7408N
1		1134-7132-00	I.C.		T.I.	SN74LS74N
32		1134-7151-00	I.C. (Memory)		Fairchild	A6C3355192
2		1023-7070-00	Capacitor	.02 uf @ 100V		
5		1023-0292-00	Capacitor	22 uf @ 15V		
4		1023-7004-00	Capacitor	47 pf +/-5% @ 500V		
1		1023-7003-00	Capacitor	500 pf +/-5%		
1		1108-0221-00	Carbon Resistor	220 Ohm 1/4W		
4		1201-4991-00	Prec. Resistor	4.99K		

PARTS LIST

INSTRUMENT TITLE Sub-Assembly MODEL "C" Amplifier

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1000-7464-01	Board #1			
1		1000-7464-02	Board #2			
1		1000-7464-03	Board #3			
1		1000-7464-04	Board #4			
1			Final Assembly			

PARTS LIST

INSTRUMENT TITLE 1090A/AR MODEL C Amplifier (Final Assy)

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1129-7003-01	Frame Housing			
1	B	1044-7025-00	Brass Shield (Horiz) (Nicolet Plug)		Richlind	
1	B	1044-7024-00	Brass Shield (Vert) (Nicolet Plug)		Richlind	
1	B	1066-7002-00	Brass Gnd Strap (Nicolet Plug)		Richlind	
1		1024-0589-00	BNC Conn (Female)			
1	fs		GND LUG FOR ABOVE			
1		1025-7177-00	Shaft & Index Assy		Centralab	
2	fs		Ceramic Spacer	11/16"	Centralab	
2	fs		Ceramic Spacer	5/8"	Centralab	P64427-00
2	fs		Ceramic Spacer	1/2"	Centralab	P28618-00
2	fs		Ceramic Spacer	5/16"	Centralab	P28265-00
2	fs		Ceramic Spacer	1/4"	Centralab	P15213-00
2	fs		Ceramic Spacer	1/16"	Centralab	
16	fs		#2 Fiber Washers	1/64"	Centralab	P20038-00
4	fs		Binding HD Mach Scrw	#4 x 1/4"		
4	fs		Fiber Washer	#4 x 1/4"		
2		1201-2492-00	1/8 W Precision	24.9K 1%	I.R.C.	
1		1026-7032-00	10-Turn Pot	100K	Helipot	7246

PARTS LIST

INSTRUMENT TITLE 1090A/AR MODEL C Amplifier (Final Assy)

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1018-7001-00	Duodial Knob	10'	Helipot	2606
1		1045-7023-00	Pointer Knob		Buckeye	
2		1123-7003-00	Captive Screw		Deutsch	
4		1023-7154-00	Trimmer Capacitor	.7-3 pf	Erie	
1			Grommet Bushing	(Nylon)	Sealectro	B1407 Part #119-0006
4			#4 Pressnut			

INSTRUMENT TITLE 1090A/AR MODEL C Amplifier (Board 1)

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7464-01	P. C. Board		Circuit Science	
1		1025-7169-00	3 Pos Slide Switch		ALCO	MSS-4300
2		1025-7167-00	2 Pos Slide Switch		ALCO	MSS-2220
1	fs	1108-0225-00	1/4 W Resistor	2.2M	A. B.	
1	fs	1108-0155-00	1/4 W Resistor	1.5M	A. B.	
1	fs	1108-0104-00	1/4 W Resistor	100K	A. B.	
2		1026-7064-00	Trimmer	1M	Helipot	89P
1		1023-7100-00	Capacitor	.22 80V	Sprague	
1		1023-7003-00	Capacitor	500 pf	Elmenco	
2		1023-7088-00	Capacitor	33 pf	Elmenco	
2	fs		Fiber Rotors		Centralab	P26937-00
1	fs		Retainer		Centralab	P26938-00
1	fs		Non Shorting Contact		Centralab	P54-882
3	fs		Contacts (Short Clip)		Centralab	
1	fs		Contacts (Long Clip)		Centralab	
4	fs		Contact Rivets			
1		1026-7075-01	Pot	50K	Bourns	3299
1		1023-7080-00	Capacitor	3.3 pf Ceramic	Elmenco	

PARTS LIST

INSTRUMENT TITLE C Amplifier MODEL Board 2

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7464-02	P. C. Board		Circuit Science	
4		1201-8003-00	1/8 W Precision	800K 1%	I.R.C.	
1		1201-1783-00	1/8 W Precision	178K 1%	I.R.C.	
1		1201-1432-00	1/8 W Precision	14.3K 1%	I.R.C.	
1		1026-7062-00	Trimmer	50K	Helipot	89P
1		1026-7057-00	Trimmer	5K	Helipot	89P
2		1023-7153-00	Capacitor	3.3 pf	Erie	301-000-C0J-339C
1		1023-7068-00	Capacitor	150 pf MICA	Elmenco	
2		1023-7155-00	Trimmer Capacitor	.25-1.5 pf	E. F. Johnson	273-0001-001
2	fs		Fiber Rotors		Centralab	P26937-00
1	fs		Retainer		Centralab	P26938-00
1	fs		Non-Shorting Contact		Centralab	P54-882
3	fs		Contacts (Short Clip)		Centralab	
1	fs		Contacts (Long Clip)		Centralab	
4	fs		Contact Rivets		Centralab	

PARTS LIST

INSTRUMENT TITLE _____ MODEL C Amplifier (Board 3)

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7464-00	PC Board		Circuit Science	
2		1201-8873-00	1/8 W Precision	887K 1%	I.R.C.	(Small size)
2		1201-8003-00	1/8 W Precision	800K 1%	I.R.C.	(806K Physically too big)
1		1201-5233-00	1/8 W Precision	523K 1%	I.R.C.	
1		1108-0473-00	1/4 W Resistor	47K	A.B.	
2		1026-7062-00	Trimmer	50K	Helipot	89P
2		1023-7091-00	Capacitor	20 pf MICA	Elmenco	
1		1023-7165-00	Capacitor	2.0 pf	Erie	301-000-C0K0-209C
2		1023-7153-00	Capacitor	3.3 pf	Erie	301-000-001-339C
2		1023-7080-00	Capacitor	3.3 pf Ceramic	CTRL.	
1		1023-7024-00	Capacitor	.01 mfd @100V Ceramic	Sprague	
2		1023-7155-00	Trimmer Capacitor	.25-1.5 pf	E.F. Johnson	273-0001-001
2	fs		Fiber Rotors		Centralab	P26937-00
2	fs		Non-Shorting Contact		Centralab	P54885
5	fs		Contacts (Short Clip)		Centralab	
2	fs		Contacts (Long Clip)		Centralab	
6	fs		Contacts Rivets		Centralab	

PARTS LIST

INSTRUMENT TITLE C Amplifier MODEL Board 4

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7464-04	P. C. Board		Circuit Science	
1		1201-4022-00	1/8 Precision	40.2K 1%	I.R.C.	
1		1201-7502-00	1/8 Precision	75K 1%	I.R.C.	
1		1201-4992-00	1/8 Precision	49.9K 1%	I.R.C.	
1		1201-3242-00	1/8 Precision	32.4K 1%	I.R.C.	
1		1201-2492-00	1/8 Precision	24.9K 1%	I.R.C.	
1		1201-6191-00	1/8 Precision	6.19K 1%	I.R.C.	
1		1201-7501-00	1/8 Precision	7.5K 1%	I.R.C.	
1		1201-4532-00	1/8 Precision	45.3K 1%	I.R.C.	
1	fs	1108-0103-00	1/4 W Resistor	10K	A. B.	
1	fs	1108-0472-00	1/4 W Resistor	4.7K	A. B.	
1	fs	1108-0102-00	1/4 W Resistor	1K	A. B.	
1	fs	1108-0470-00	1/4 W Resistor	47 Ohm	A. B.	
2	fs	1108-0220-00	1/4 W Resistor	22K	A. B.	
2	fs	1108-4702-00	1/4 W Resistor	47K	A. B.	
1		1026-7060-00	Trimmer	20K	Helipot	89P
1		1023-7080-00	Capacitor	3.3 pf Ceramic		
5		1023-7024-00	Capacitor	.01 uf @ 100V Ceramic	Sprague	

INSTRUMENT TITLE C Amplifier MODEL Board 4

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1021-7032-00	Dual F.E.T.		T. I.	2N5047
2		1021-7018-00	Transistor		Motorola	2N3905
1		1021-7047-00	Transistor		Motorola	2N5224
1		1021-7006-00	Transistor		Motorola	2N2484
2	fs		Fiber Rotors		Centralab	P26937-00
1	fs		Non-Shorting Contact		Centralab	P55280
1	fs		Non-Shorting Contact		Centralab	
3	fs		Contacts (Short Clip)		Centralab	
3	fs		Contacts (Long Clip)		Centralab	
5	fs		Contact Rivets		Centralab	
1		1024-7125-00	Connector	Modified-Lugs cut-off 20 Pin	Cinch	50-20-B-10
1		1022-7098-00	Dual Diode		Fairchild	FJT-2000

PARTS LIST

INSTRUMENT TITLE D Amplifier MODEL Sub-Assembly

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1000-7479-01	Combination Brd.			
1		1000-7479-01	Combination Brd.			
1		1000-7476-00	Board 3 Asmb.			
1		1000-7464-00	Board 4 Asmb.			
1			Final Assembly			

PARTS LIST

INSTRUMENT TITLE Final Asmb. MODEL "D" Amplifier

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1044-7027-00	Horiz. Shield	Small (Brass)		
1	B	1044-7028-00	Horiz, Shield	Large (Brass)		
A/R	B	1129-7004-01	Frame Housing	(For M93A only)		
A/R		1129-7002-01	Frame Housing	(For M93 only)		
2	B	1044-7024-00	Vert. Shield	(Brass)		
1	B	1066-7002-00	Ground Strap	(Brass)		
2		1024-0589-00	BNC Conn.	Female		
2	fs		Gnd. Lug (for above)			
1		1025-7177-00	Shaft & Index Assy.		Centralab	
2	fs		Ceramic Spacer	7/16 O.L.	(Sub(1) 5/16 (2)	1/16)
2	fs		Ceramic Spacer	1/40 L.		
2	fs		Ceramic Spacer	1/8 O.L.	(Sub (2) 1/16	
6	fs		Ceramic Spacer	1/2 O.L.		
20	fs		Fiber Washer	#2x1/64		P20038-00
4	fs		Fiber Washer	#4x1/16		
1		1201-2492-00	1/8W Prec. Res.	24.9K 1%		
1		1026-7076-00	IO Turn Pot	1K	Bourns	
1		1018-7001-00	Duodial Knob Assy.		Helipot	

PARTS LIST

INSTRUMENT TITLE Final Asmb. MODEL "D" Amplifier

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1045-7023-00	Pointer Knob			
2			Captive Screw	#4x5/16		
4		1023-7154-00	Capacitor, Trimmer	0-7 pf - 3 pf	Erie	
1		1023-7135-00	Capacitor	4.7 uf @ 50V		

PARTS LIST

INSTRUMENT TITLE Combination Brd. 1 MODEL "D" Amplifier

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7479-01	Comb Brd.			
1		1025-7169-00	3 pos Slide Switch		Alco	MSS4300
1		1025-7167-00	2 pos Slide Switch		Alco	MSS2220
1		1108-7169-00	1/4W Resistor	2.2m		
1		1108-0155-00	1/4W Resistor	1.5m		
2		1026-7064-00	Trimmer	1m	Helipot	89P
1		1023-7100-00	Capacitor	.22 uf @ 80V		
2		1023-7003-00	Capacitor	500 pf		
3		1023-7088-00	Capacitor	33 pf		
2	FS		Fiber Rotor		Centralab	P26937-00
2	FS		Non Shrtng Contact		Centralab	PS4882
6	FS		Contacts (Short Clips)		Centralab	P14242-00
2	FS		Contacts (Long Clip)		Centralab	P14243-00
8			Contact Rivets		Centralab	P18633-11
1		1026-7075-01	Pot	50K	Bourns	3292
1		1023-7080-00	Capacitor	3.3 pf	Ceramic	
4		1201-8003-00	1/8 W Prec. Res.	800K 1%		

PARTS LIST

INSTRUMENT TITLE Comb Board 1 MODEL "D" Amplifier

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1201-1783-00	1/8W Prec. Res.	178K 1%		
1		1201-1432-00	1/8W Prec. Res.	14.3K 1%		
1		1026-7062-00	Trimmer	50K	Helipot	89P
1		1026-7057-00	Trimmer	5K		
2		1023-7155-00	Trimmer Cap	.25-1.5pf	E. F. Johnson	
1			Capacitor	100pf		
2		1025-7191-00	2 pos. Slide Switch		Alco	MSS-44
1			Cap	20pf		
1		1023-7153-00	Capacitor	3.3 pf	Erie	301-000-003 (309C)

PARTS LIST

INSTRUMENT TITLE "D" Amplifier MODEL Comb Board 2

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7479-01	Comb Board			
3		1023-7088-00	Capacitor	33 pf		
1		1023-7092-00	Capacitor	200 pf	Elmenco	DM-15-201-J
2		1023-7155-00	Trimmer Cap.	.25-1.5 pf	E. F. Johnson	
1		1108-0225-00	1/4 W Resistor	2.2M		
1		1108-0155-00	1/4 W Resistor	1/5M		
4		1201-8003-00	1/8 W Prec. Res.	800K 1%		
1		1201-1783-00	1/8 W Prec. Res.	178K 1%		
1		1201-1432-00	1/8 W Prec. Res.	14.3K 1%		
2	fs		Fiber Rotor		Centralab	P26937-00
2	fs		Non-Shorting Contact			P54882
6	fs		Contact (Short Clip)			P14242-00
2	fs		Contact (Long Clip)			P14243-00
8	fs		Contact Rivet			P18633-11
1		1026-7062-00	Trimmer	50K	Helipot	89P
1		1026-7057-00	Trimmer	5K	Helipot	89P
2		1026-7064-00	Trimmer	1M		
1		1023-7080-00	Capacitor	3.3 pfd		

PARTS LIST

INSTRUMENT TITLE "D" Amplifier MODEL Comb Board 2

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1			Cap	3.3 pfd	Erie Cap	
1			Cap	500 pfd		
1			Cap	20 pfd		

INSTRUMENT TITLE Board 3 MODEL "D" Amplifier

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7476-01	Board 3			
2		1023-7091-00	Capacitor	20 pf @ 500V	MICA	
2		1023-7164-00	Capacitor	12 pf @ 50V	MICA	DM5CC120J
8		1023-7070-00	Capacitor	.02 pf	Ceramic	
1		1023-7155-00	Trimmer Cap	.25-1.5 pf	E. F. Johnson	
2		1201-4121-00	1/8 Prec. Res.	4.12K		
1		1201-2211-00	1/8 Prec. Res.	2.21K		
3		1201-2001-00	1/8 Prec. Res.	2K		
1		1201-6490-00	1/8 Prec. Res.	649 Ohm		
2		1201-4999-00	1/8 Prec. Res.	49.9 Ohm		
1		1201-4020-00	Prec. Res.	402 Ohm 1%		
2		1108-0105-00	1/4 W Resistor	1M		
2		1108-0104-00	1/4 W Resistor	100K		
3		1108-0223-00	1/4 W Resistor	22K		
2		1108-0153-00	1/4 W Resistor	15K		
1		1108-0103-00	1/4 W Resistor	10K		
1		1108-0332-00	1/4 W Resistor	3.3K		
1		1108-0102-00	1/4 W Resistor	1K		

PARTS LIST

PAGE ___ OF ___

INSTRUMENT TITLE Board 3 MODEL "D" Amplifier

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1		1021-7032-00	Dual Fet.			2N5047
6		1021-7018-00	Transistor			2N3905
2		1021-7022-00	Transistor			2N3903
2		1022-7064-00	Zener Diode	13V	Motorola	1N5243B
3		1022-7037-00		5.1V	Motorola	1N5231B
2		1022-7098-00	Dual Diode		Fairchild	FJT-2000
2	fs		Fiber Rotor		Centralab	P26937-00
1	fs		Retainer		Centralab	P26938-00
1	fs		Non-Shorting Contact		Centralab	P54885
4	fs		Contact (Short Clip)		Centralab	P14242-00
4	fs		Contact Rivet		Centralab	P18633-11
2		1026-7053-00	Trimmer	20 Turn/200 Ohm	Helipot	89P
1		1026-7077-00	Trimmer	1 Turn/200 Ohm	Helitrim	62 PR 200

PARTS LIST

INSTRUMENT TITLE Board 4 MODEL "D" Amplifier

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
1	B	1000-7464-04	Board 4			
1		1023-7080-00	Capacitor	3.3 pf	Ceramic	
5		1023-7024-00	Capacitor	.01 u @100V	Ceramic	
1		1021-7032-00	Dual Fet.			2N5047
2		1021-7018-00	Transistor		Motorola	2N3905
1		1021-7047-00	Transistor		Motorola	2N5224
1		1021-7006-00	Transistor		T.I.	2N2484
1	fs	1108-0683-00	1/4W Prec. Res.	68K		
1	fs	1108-0473-00	1/4W Prec. Res.	47K		
1	fs	1108-0103-00	1/4W Prec. Res.	10K		
1	fs	1108-0681-00	1/4W Prec. Res.	680		
1	fs	1108-0102-00	1/4W Prec. Res.	1K		
1	fs	1201-2002-00	1/4W Prec. Res.	20K		
1		1201-8251-00	1/8W Prec. Res.	8.25K		
1		1201-1651-00	1/8W Prec. Res.	1.65K		
2	fs		Fiber Rotor		Centralab	P26937-00
1	fs		Non-Shorting Contact			P55280
1	fs		Non-Shorting Contact			P40004-11

INSTRUMENT TITLE Board 4 MODEL "D" Amplifier

REQ.	✓	STOCK NUMBER	DESCRIPTION	VALUE	MANUFACTURER	MFG. NUMBER
3	fs		Contact (Short Clip)			P14242-00
3	fs		Contact (Long Clip)			P14243-00
5	fs		Contact Rivet			P18633-11
1	fs	1108-0100-00	Resistor	1/4W 100 Ohm		
1		1201-4992-00	1/8W Prec. Res.	49.9K		
1		1201-1242-00	1/8W Prec. Res.	12.4K		
1		1201-6191-00	1/8W Prec. Res.	6.19K		
1		1201-7501-00	1/8W Prec. Res.	7.5K		
1		1201-2492-00	1/8W Prec. Res.	24.9K		
1		1201-2491-00	1/8W Prec. Res.	2.49K		
1		1201-6192-00	1/8W Prec. Res.	61.9K		
1		1026-7063-00	Trimmer	100K	Helipot	89P
1		1024-7125-01	Conn/Mod	Use A Matl. 1024-7125-00		

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